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The Structure and Outlook for the US Biofuels Industry

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Background: US Biofuels Industry

Biofuels are liquid transportation fuels made from plant matter instead of petroleum. Ethanol and biodiesel—the primary biofuels today—can be blended with or directly substitute for gasoline and diesel, respectively. Biofuel production—particularly ethanol—has shown a strong upward trajectory since the mid 1990's, driven especially by federal policies aimed at promoting ethanol use as a means of reducing air and water pollution. Biofuels are also widely promoted as a means of reducing dependence on foreign oil and reducing greenhouse gas emissions (which reduces concerns about global warming), and have proven to be an engine of economic activity that directly benefits the agricultural economy.

The primary categories of biofuels include:

- **Ethanol**, also known as ethyl alcohol or grain alcohol, can be used either as an alternative fuel or an octane-boosting, pollution-reducing additive to gasoline.
    - **Ethanol from Grain** (chiefly the starch in kernels of field corn) is the primary means of current ethanol production in the United States.
    - **Advanced Bioethanol Technology** allows fuel ethanol to also be made from cellulosic (plant fiber) biomass, such as agricultural forestry residues, industrial waste, material in municipal solid waste, and trees and grasses.
- **Biodiesel**, made from animal fat or vegetable oil, is a renewable pollution-reducing alternative to petroleum diesel.
- **E-Diesel**, a fuel that uses additives to allow blending of ethanol with diesel, is being developed by several companies.
- **Methanol**, also known as "wood alcohol," can be made thermochemically from biomass, but is now usually made from natural gas or coal. Research on biomass methanol has waned, because making ethanol from cellulosic material now shows greater promise

Ethanol is by far the largest biofuels market segment in the United States today, with corn the primary feedstock. But there is growing interest and continuing research into alternative feedstocks for ethanol production as well as the use of oil-based feedstocks for use in producing biodiesel and bio-based industrial lubricants.

Ethanol: Market and Industry Structure

- The modern US ethanol industry traces its origins to the "oil shocks" of 1973 and 1979 that generated interest in renewable energy sources. In the late 1970's and early 1980's federal and state governments provided research funds for projects targeted at converting grain crops and agricultural wastes into energy. Subsidies such as concessionary interest rates and grants also became available for the construction of facilities to produce energy from renewable feedstocks such as corn. An exemption from the federal excise tax on gasoline helped make ethanol cost-competitive.

- In 1990, a new source of demand for ethanol was created as amendments to the Clean Air Act (referred to as CAA90) established two programs to reduce automotive pollution by mandating specifications for "cleaner" fuel. The Oxygenated Fuels Program (OXY Program) was targeted at reducing carbon monoxide emissions, while the Reformulated Gasoline Program (RFG Program) was intended to reduce smog-forming emissions. Ethanol and methyl tertiary butyl ether (MTBE) have been the two main oxygenates (i.e., additives that increase the oxygen content in fuel) used to meet the requirements of these programs.

- In 1990, the US ethanol industry consisted of 13 main companies operating 17 facilities with capacities of at least 10 million gallons per year (mmgy), as well as a number of operations with capacities below 10 mmgy. The total capacity of the industry was 1.11 billion gallons per year (bgy), and one participant, Archer Daniels Midland (ADM), had 55% of industry capacity (see Table 1). The next-largest company had a market share of 7%.

Table 1: US Fuel Ethanol Production Capacity as of August 1990 (mmgy)

Company	City	State	Capacity
Archer Daniels Midland	Decatur	IL	275
Archer Daniels Midland	Peoria	IL	150
Archer Daniels Midland	Cedar Rapids	IA	95
Pekin Energy	Pekin	IL	80
Archer Daniels Midland	Clinton	IA	80
New Energy Co. of Indiana	South Bend	IN	70
South Point Ethanol	South Point	OH	60
A. E. Staley Company	Loudon	TN	40
BioCom USA, Ltd.	Jennings	LA	35
Midwest Grain Products	Atchison	ND	12
American Diversified Co.	Hastings	NE	12
Energy Fuels Development	Portales	NM	12
Archer Daniels Midland	Walhalla	ND	11
The Hubinger Company	Keokuk	IA	11
Minnesota Corn Processors	Marshall	MN	10
Grain Processing Corporation	Muscatine	IA	10
High Plains Corporation	Wichita	KS	10
Facilities with capacities below 10 million gallons			138
Total			1,111

- In response to CAA90, US ethanol production tripled, from nearly one billion gallons in the early 1990s to 2.8 billion gallons in 2003. The economics of ethanol production have been particularly strong in the last three to five years, due to substantial periods when low corn prices have coincided with high gasoline prices.

- Adding to the demand for ethanol, several states have taken steps to ban MTBE, the main competitor against ethanol in the fulfillment of the CAA90 oxygen requirements. These bans have been ordered because of the health concerns associated with contamination of groundwater by MTBE in a number of locations. Of particular note is California, by far the largest gas-consuming state in the country, where its own statewide reformulated gasoline program has been implemented.

- In response to positive margins and impending state MTBE bans, ethanol production capacity expanded rapidly to 3.1 billion gallons by the end of 2003, with another 492 million gallons under construction, according to the Renewable Fuels Association. As of May 2004, capacity had expanded further, to 3.3 billion gallons, with an additional 423 million gallons under construction. As of May 2005, the industry consisted of 71 organizations operating 82 facilities with a total capacity of nearly 3.8 billion gallons (Table 2). Just over half of the facilities are farmer-owned.

Table 2: US Fuel Ethanol Capacity as of April 2005 (mmgy)

Company	City	State	Capacity	Company	City	State	Capacity
Abengoa Bioenergy Corp.	York	NE	55	Husker Ag, LLC*	Plainview	NE	24
	Colwich	KS	25	Iowa Ethanol, LLC*	Hanlontown	IA	55
	Portales	NM	15	James Valley Ethanol, LLC	Groton	SD	50
ACE Ethanol, LLC	Stanley	WI	30	KAAPA Ethanol, LLC*	Minden	NE	40
Adkins Energy, LLC*	Lena	IL	40	Land O' Lakes*	Melrose	MN	2.6
AGP*	Hastings	NE	52	Lincolnland Agri-Energy, LLC*	Palestine	IL	40
Agra Resources Coop. d.b.a. EXOL*	Albert Lea	MN	40	Little Sioux Corn Processors, LP*	Marcus	IA	49
Agri-Energy, LLC*	Luverne	MN	21	Merrick/Coors	Golden	CO	1.5
Alchem Ltd. LLLP	Grafton	ND	10.5	MGP Ingredients, Inc.	Pekin	IL	78
Al-Corn Clean Fuel*	Claremont	MN	30		Atchison	KS	
Archer Daniels Midland	Decatur	IL	1,070	Michigan Ethanol, LLC	Caro	MI	50
	Cedar Rapids	IA		Mid-Missouri Energy, Inc.*	Malta Bend	MO	45
	Clinton	IA		Midwest Grain Processors*	Lakota	IA	50
	Columbus	NE		Midwest Renewable Energy, LLC	Sutherland	NE	15
	Marshall	MN		Miller Brewing Co.	Olympia	WA	0.7
	Peoria	IL		Minnesota Energy*	Buffalo Lake	MN	18
	Wallhalla	ND		New Energy Corp.	South Bend	IN	102
Aventine Renewable Energy, Inc.	Pekin	IL	100	North Country Ethanol, LLC*	Rosholt	SD	20
	Aurora	NE	40	Northeast Missouri Grain, LLC*	Macon	MO	40
Badger State Ethanol, LLC*	Monroe	WI	48	Northern Lights Ethanol, LLC*	Big Stone City	SD	50
Big River Resources, LLC*	West Burlington	IA	40	Otter Creek Ethanol, LLC*	Ashton	IA	55
Broin Enterprises, Inc.	Scotland	SD	9	Parallel Products	Louisville	KY	5.4
Cargill, Inc.	Blair	NE	85		R. Cucamonga	CA	
	Eddyville	IA	35	Permeate Refining	Hopkinton	IA	1.5
Central MN Ethanol Coop*	Little Falls	MN	20.5	Pine Lake Corn Processors, LLC*	Steamboat Rock	IA	20
Central Wisconsin Alcohol	Plover	WI	4	Platte Valley Fuel Ethanol, LLC	Central City	NE	40
Chief Ethanol	Hastings	NE	62	Pro-Corn, LLC*	Preston	MN	40
Chippewa Valley Ethanol Co.*	Benson	MN	45	Quad-County Corn Processors*	Galva	IA	23
Commonwealth Agri-Energy, LLC*	Hopkinsville	KY	23	Reeve Agri-Energy	Garden City	KS	12
Corn Plus, LLP*	Winnebago	MN	44	Siouxland Energy & Livestock Coop*	Sioux Center	IA	22
Dakota Ethanol, LLC*	Wentworth	SD	50	Sioux River Ethanol, LLC*	Hudson	SD	55
DENCO, LLC*	Morris	MN	21.5	Tall Corn Ethanol, LLC*	Coon Rapids	IA	49
ESE Alcohol Inc.	Leoti	KS	1.5	Tate & Lyle	Loudon	TN	67
Ethanol2000, LLP*	Bingham Lake	MN	30	Trenton Agri Products, LLC	Trenton	NE	30
Glacial Lakes Energy, LLC*	Watertown	SD	50	U.S. Energy Partners, LLC	Russell	KS	40
Golden Cheese Company of CA*	Corona	CA	5	Utica Energy, LLC	Oshkosh	WI	48
Golden Grain Energy, LLC*	Mason City	IA	40	VeraSun Energy Corporation	Aurora	SD	102
Golden Triangle Energy, LLC*	Craig	MO	20	Voyager Ethanol, LLC*	Emmetsburg	IA	50
Grain Processing Corp.	Muscatine	IA	20	Western Plains Energy, LLC*	Campus	KS	30
Great Plains Ethanol, LLC*	Chancellor	SD	50	Wyoming Ethanol	Torrington	WY	5
Hawkeye Renewables, LLC	Iowa Falls	IA	45	Total Existing Capacity			3,761
Heartland Corn Products*	Winthrop	MN	36				
Heartland Grain Fuels, LP*	Aberdeen	SD	8				
	Huron	SD	14				

Source: Renewable Fuels Association
* Indicates farmer-owned facility

- The ethanol industry has one large participant, Archer Daniels Midland (ADM), that exerts a certain amount of leadership with respect to marketing of ethanol, as well as several medium-sized producers, including Abengoa, Aventine Renewable Energy and Cargill, which also market a considerable amount of ethanol. Beyond these companies the ethanol industry is relatively fragmented, with many small, independent firms and cooperatives. The structure of federal and many state incentives, together with the advantages of a cooperative structure, have favored the creation of small to medium-sized facilities and kept the industry fragmented compared to other agricultural processing industries. ADM is still the industry leader – its 1.07 bgy capacity is almost as large as the entire industry was in 1990 – but given the growth of the rest of the industry, its market share has fallen to 28%. Still, given the establishment of a large number of medium-sized facilities, the next-largest company has a market share of only 4%.

- State bans of MTBE, a competing additive used to boost oxygen content in gasoline, have been a major cause of the expansion in ethanol consumption in recent years. To date, 20 states have implemented or announced bans of MTBE, most notably California and New York, where bans took effect at the beginning of 2004. If it were not for the fact that MTBE was found to be carcinogenic and a source of groundwater pollution, the political fight between the energy industry and the agriculture sector would have continued, and support for ethanol production would not be nearly as vigorous as it currently is. Current energy legislation (discussed later in this report) eliminates the oxygenate requirement for gasoline and replaces it with a Renewable Fuels Standard, which directly encourages ethanol use instead of MTBE.

- It is estimated that facilities that use corn and/or sorghum as the primary feedstocks account for roughly 95% of industry capacity, with corn alone accounting for nearly 90%. As a result, ethanol facilities tend to be geographically concentrated in intensive corn-production regions, mainly in the Corn Belt states (Figure 1)

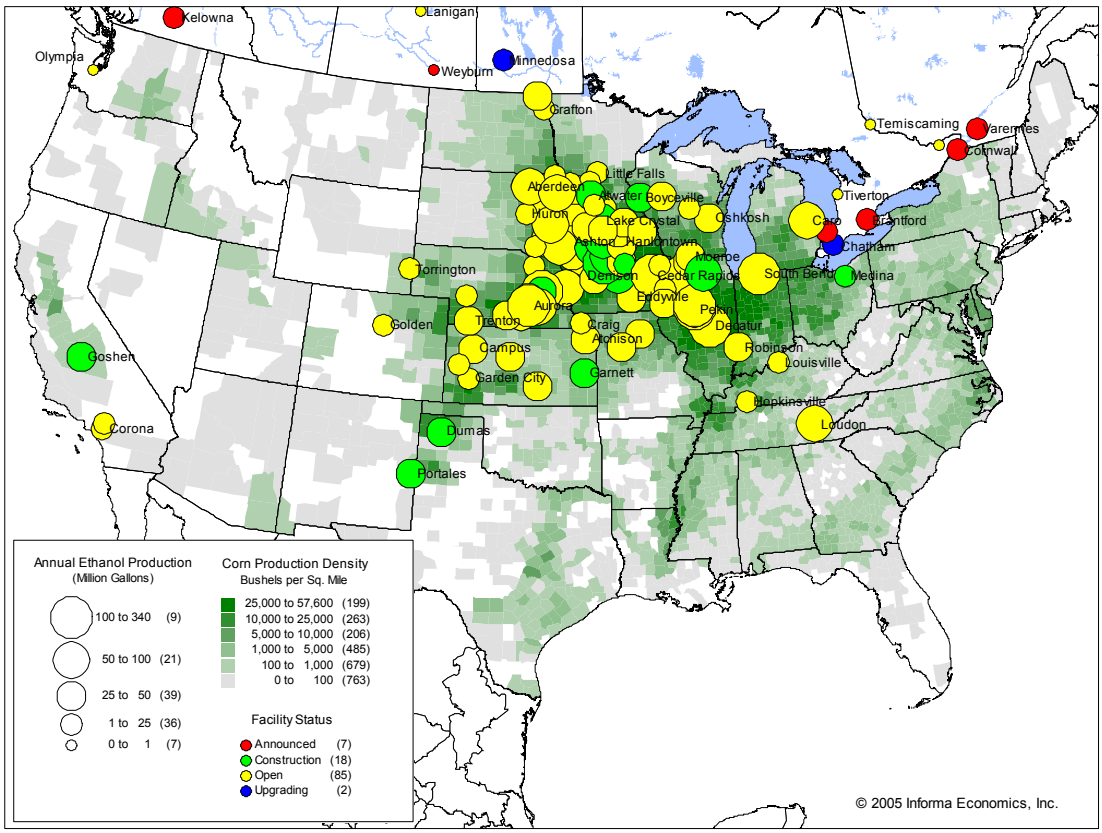
Tax Incentives for Alcohol Fuels

- The primary federal incentive for ethanol is the exemption of 10%-ethanol blends from $0.052 of the $0.184 federal excise tax on each gallon of motor fuel. Because the exemption applies to 10% blends, it amounts to an effective subsidy of $0.52 per gallon of pure ethanol ($0.052 ÷ 10%). Additionally, since January 1993, ethanol-gasoline blends consisting of 7.7% or 5.7% alcohol have received a prorated exemption, which would still equate to $0.52 per gallon of pure ethanol. These blends correspond to the 2.7% and 2.0% oxygen content standards for gasoline sold in RFG and OXY Program areas, respectively.

- Tax savings incurred from the excise tax exemption do not go to the ethanol producer directly but rather are available to the gasoline companies as an incentive to promote the use of ethanol. The gasoline companies, in turn, pay a premium that varies but generally is moderately less than $0.52 per gallon over wholesale gasoline prices to

purchase ethanol for blending in gasoline. The federal government also provides three categories of income tax credits associated with ethanol: the alcohol blenders' tax credit (essentially an alternative to the excise tax exemption), the straight alcohol credit, and the small ethanol producers' credit. Other programs that support ethanol production include the Federal Bioenergy Program ("CCC 850"), which subsidizes a portion of the cost of the additional grain that an ethanol facility commits to use, compared to consumption in the previous year (it also applies to oilseeds used in biodiesel production).

Figure 1. Geography of the US Ethanol Industry



- Many states also provide separate incentives for ethanol production. Nebraska was one of the pioneers in offering an incentive as a way to attract ethanol companies to the state, with a number of facilities locating there in the early to mid-1990s. The state currently offers a 20 cent/gallon subsidy, and a 2001 law provided for subsidies extending over eight years for facilities that were able to produce at least minimal levels of ethanol by June 30, 2004. State production incentives have tended to be capped at a certain capacity level, which has contributed to the fragmented nature of the industry. The recent Minnesota requirement that gasoline sold there be blended with 10% ethanol has been held up as a model state policy to promote ethanol production.

Corn as an Ethanol Feedstock

Corn is by far the largest feedstock used in US ethanol production, accounting for about 90% of all ethanol production capacity. Hence, reliable corn supplies at competitive prices are key to maintaining an efficient and competitive ethanol sector and ensuring that individual plants remain profitable under existing market conditions. Because of climate and geography that are very favorable to corn production, the US is one of the world's major producers of corn, representing 40% of the world's total production.

Just over half of US corn production is used in livestock and poultry feed (including both domestic use and exports), although the rate of growth in the feed utilization of corn is relatively slow, averaging 1.8% annually from the 1990/91 to 2003/04 September-August crop marketing years. Corn is by far the dominant feed grain used in the US, with less than 10% of feeding coming from other grains. Substitution of other grains for corn is a function of availability, nutritional content and price. It is notable that the middle-protein co-products of ethanol processing, corn gluten feed (from wet-milling) and distillers grains, still represent only about 6% of the volume of grain-oriented products fed to livestock and poultry, despite the doubling of US ethanol capacity since 2000.

Historically, exports of corn have also been an important source of demand, although exports have been relatively stagnant since the end of the 1995/96 crop year, when 2.2 billion bushels were exported. Starting in the 1996/97 crop year, exports have remained within a range of 1.5 to 2.0 billion bushels annually, similar to levels experienced during the late 1980s. Exports now account for approximately 18% of the total usage of US corn. Corn exports vary from year to year due to a variety of factors, including domestic supply and available supply from competing countries.

Since the modern ethanol industry was born in the late 1970's, the "food, seed and industrial" (FSI) category of corn usage has grown significantly, now accounting for 25% of total consumption (Chart 1). FSI usage has grown at a rapid 4.7% per year since 1990/91, and the growth rate has accelerated to double digits over the last few years as ethanol capacity continued to expand.

The FSI category of corn utilization also includes the production of high fructose corn syrup (HFCS), a widely used sweetener, as well as corn starch. However, practically all of the expansion of the FSI category in recent years has been due to ethanol production, as all other major FSI categories decreased in their share of the total while ethanol now accounts for nearly 52% of FSI usage (Chart 2).

Virtually all of the ethanol plants built over the last decade have used dry-mill technology. Dry-mill corn grind for ethanol production has increased from less than 150 million bushels as recently as 1996 to nearly 1 billion bushels expected for the 2005-06 crop year. Wet-mill corn grind for ethanol has been relatively steady at just under 500 million bushels per year (Chart 3). Based on national average corn yields and standard ethanol extraction rates, ethanol production in 2005 would consume the amount of corn produced on nearly 10.3 million acres, up from about 3.4 million acres in 1996 (Chart 4).

Chart 1: Major Categories of Corn Use

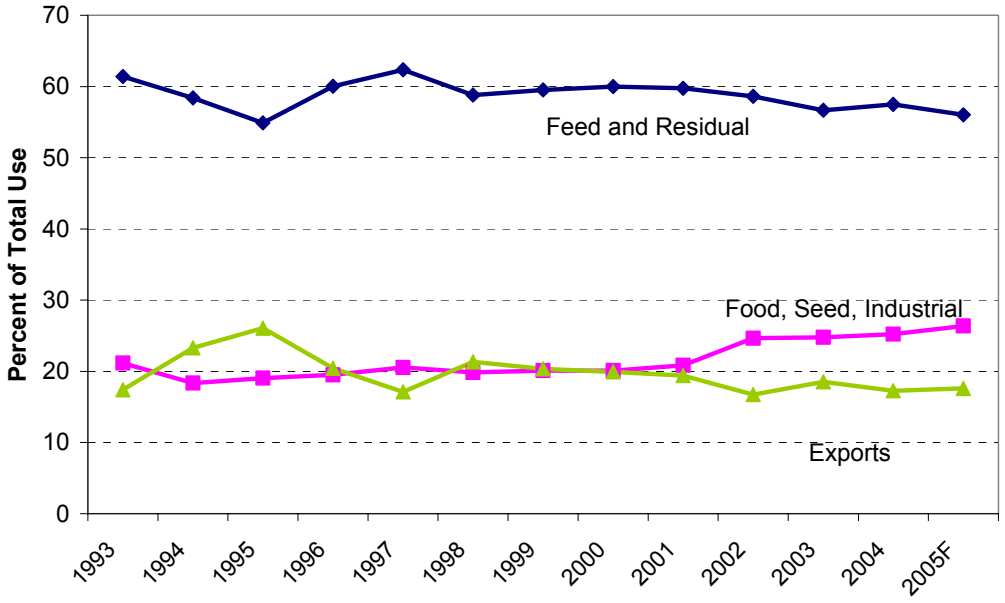


Chart 2: Food, Seed and Industrial Use by Major Category

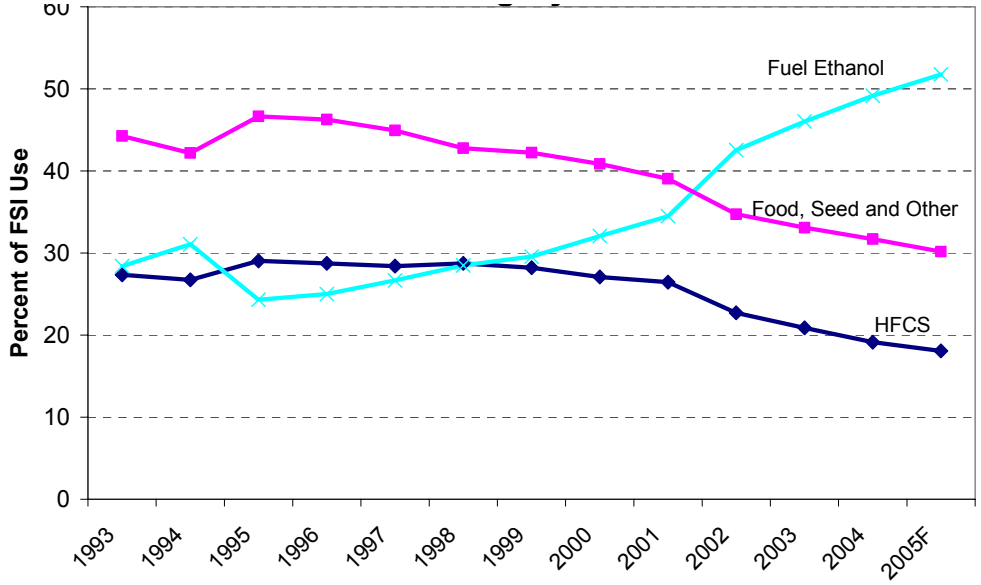


Chart 3: US Ethanol Corn Grind

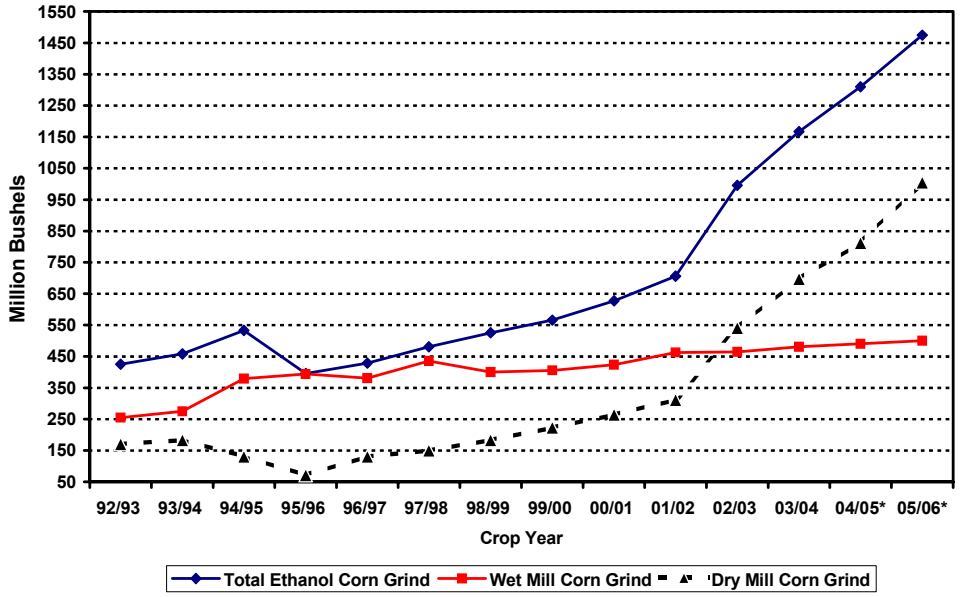
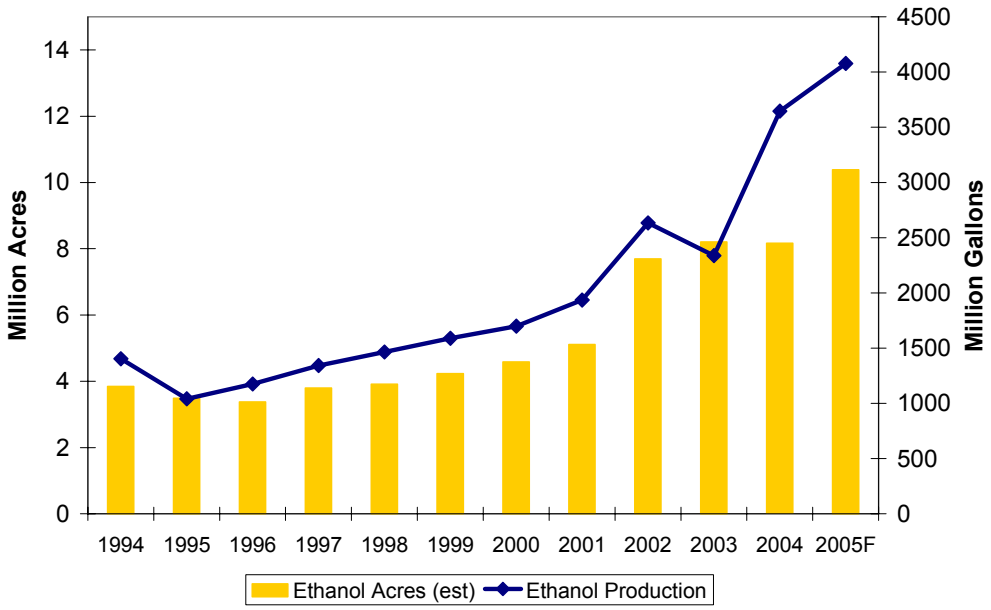


Chart 4: Estimated Corn Acreage to Support Ethanol Production



The US corn crop is expected to remain above 10 billion bushels during future years. Corn production of about 10.9 billion bushels in 2005 will be below the record 11.8 billion-bushel harvest of 2004, but is expected to trend steadily higher in the coming years to reach 12.9 billion bushels by 2014. Importantly, this forecast assumes that "normal" weather patterns will occur each year during the period, as it is not possible to

forecast abnormally favorable weather or a drought in any specific year over a long time horizon. Therefore, yields are assumed to continue to increase in line with their long-term trend. Any substantial deviation from normal weather will have an impact on the actual price and market conditions experienced in any given year or series of years. The supply/demand forecast incorporates expectations that continuing expansion of ethanol production will require additional corn acreage.

Federal Policies to Promote Ethanol Production and Use

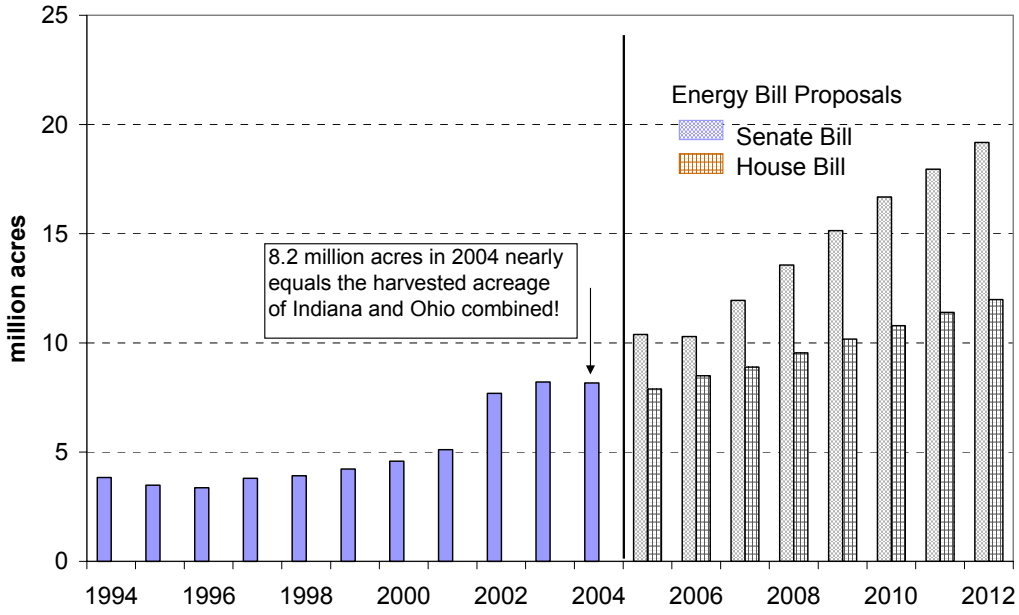
Public policy (at both the state and federal levels) continues to be the driving force behind future demand prospects for ethanol. Congress worked for five years to pass legislation setting a national energy policy. The Energy Bill that was finally signed into law in July is very supportive of ethanol production, and should ensure an expanding market for US ethanol and other biofuels over a multi-year time period. Some of the details of the new law include:

Renewable Fuel Standard: In order to reduce fossil-fuel consumption, the agreement increases the specified amount of renewable fuel that gasoline sold in the United States must contain. Ethanol made from corn is the renewable fuel additive expected to be utilized the most by gasoline producers to reach this goal. As such, the law now requires the Federal Trade Commission to conduct an analysis (within 180 days of enactment) of the market concentration of ethanol, and to determine whether there is enough industry competition to avoid price-setting or other anti-competitive behavior. The renewable fuels standard replaces the previous oxygenate requirement.

Under the measure, the annual average volume of renewable fuel additives would start at 4 billion gallons in 2006 and increase to 4.7 billion in 2007, 5.4 billion in 2008, 6.1 billion in 2009, 6.8 billion in 2010 and 7.4 billion in 2011 before hitting the long-term goal of 7.5 billion gallons by 2012. Starting in 2013 and thereafter, the amount of fuel additives would be determined by EPA, USDA, and the Energy Department (DOE), and would be based on the experience of increasing fuel additives in the previous seven years.

The 7.5 billion gallon Renewable Fuel Standard by 2012 closely matched the Senate's latest version of the Energy Bill, and would result in the need for a near doubling of ethanol production over the upcoming 6 year period. If the renewable fuel standard were to be met exclusively using corn based ethanol, corn acreage necessary to supply the growing ethanol industry would need to expand by nearly 10 million acres (at existing average yields), almost double the 10.4 million acres that are expected to be used to support the nearly 4 billion gallons of ethanol likely to be produced this year (Chart 5). The RFS also applies to biodiesel and cellulosic ethanol, with the production of cellulosic ethanol counting toward 2.5 gallons of RFS. However, cellulosic ethanol technology is still extremely immature and is unlikely to be a significant contributor to the nation's ethanol supply at least until 2010.

Chart 5: Estimated Corn Requirement to Support RFS Goals Under Current Yields



The actual expansion in corn acreage necessary to supply the RFS provisions in the current energy bill will depend on many factors, including the extent to which average corn yields improve in future years, the amount of corn that is diverted to ethanol from other existing markets, and future technological improvements in the efficiency with which ethanol can be derived from corn or other sources. Yield improvements should offset some of the need for expanded corn acreage, but it is difficult to predict yield patterns several years out especially if more marginal land is attracted to corn production that has lower than average yields. Regardless, current projections see the need for up to 2.9 billion bushels of grain to support ethanol production by 2014, a dramatic expansion from the estimated 1.45 billion bushels that will be used in 2005. With a projected trend yield of just over 165 bushels per acre in 2014, an additional 4 million acres of corn will be needed to supply existing markets and new, expanded ethanol markets.

State Waivers: Under the agreement, EPA, in consultation with USDA and DOE, would have the authority to reduce or waive the renewable fuels standard requirement if they determine that the mandate would have a significant adverse economic or environmental effect on a state or region, or that there is an inadequate renewable-fuel supply or distribution capacity to meet the requirement. Any waiver granted would last one year, but could be renewed. DOE also could waive the requirement if it determines that the mandate would impose an economic hardship on a refinery.

The measure also directs DOE to conduct a study within 180 days of enactment to determine whether the renewable fuels mandate will harm consumers on a national, state or regional basis in 2006. The department would report its findings and make recommendations to EPA, which then would have discretion to reduce or eliminate the mandate for the relevant state or region.

Other Ethanol Provisions: The conference agreement also authorizes $110 million in each of fiscal years 2005 through 2009 for demonstration projects to produce biodiesel fuel from biomass ethanol. It authorizes $100 million in FY06, $250 million in FY07 and $400 million in FY08 for grants to assist producers to construct facilities to make ethanol or other renewable fuels. In addition, it authorizes loan guarantees for projects that could produce ethanol using sugarcane or sugarcane by-products. The energy bill also redefined a small ethanol producer as a plant with a 60 million gallon per year capacity, up from 30 million. Small ethanol producers get a 10¢/gallon tax credit for the first 15,000 gallons of production

MTBE: The bill contains no provision to protect MTBE makers from lawsuits by cities and others for contaminating water supplies. However, it does allow any parties involved in a lawsuit regarding MTBE to request that the case be moved from a state court to a federal district court. The bill does eliminate the oxygenate requirement for fuels sold in high-pollution areas, but it does not provide for a phase out of MTBE. The agreement requires EPA to conduct a study of the public health and environmental effects of using fuel additives other than MTBE and to complete the study within two years of enactment. In addition, it requires the EPA to establish standards to reduce toxic air pollutants from gasoline with fuel additives.

Renewable Energy: The bill contains a number of provisions to encourage the use of renewable energy and subsequently decrease reliance on fossil fuels. For example, it directs DOE each year to review and report on renewable energy sources in the United States, such as wind power, solar energy and biofuels, and it authorizes $10 million in each of the five fiscal years 2006 through 2010 to fund the annual report.

Biomass Grants: The measure authorizes USDA and the Interior Department to provide grants to owners and operators of facilities that produce electricity, heat or petroleum substitutes using trees, plants, brush and wood chips. To be eligible, the biomass would need to be derived from efforts to thin national parks and forests as a means of preventing forest fires or of reducing disease or insect infestation. The measure authorizes $50 million in each of fiscal years 2006 through 2016 to carry out both of these biomass grant programs. Grants would be limited to not more than $500,000.

Short-term Ethanol Outlook

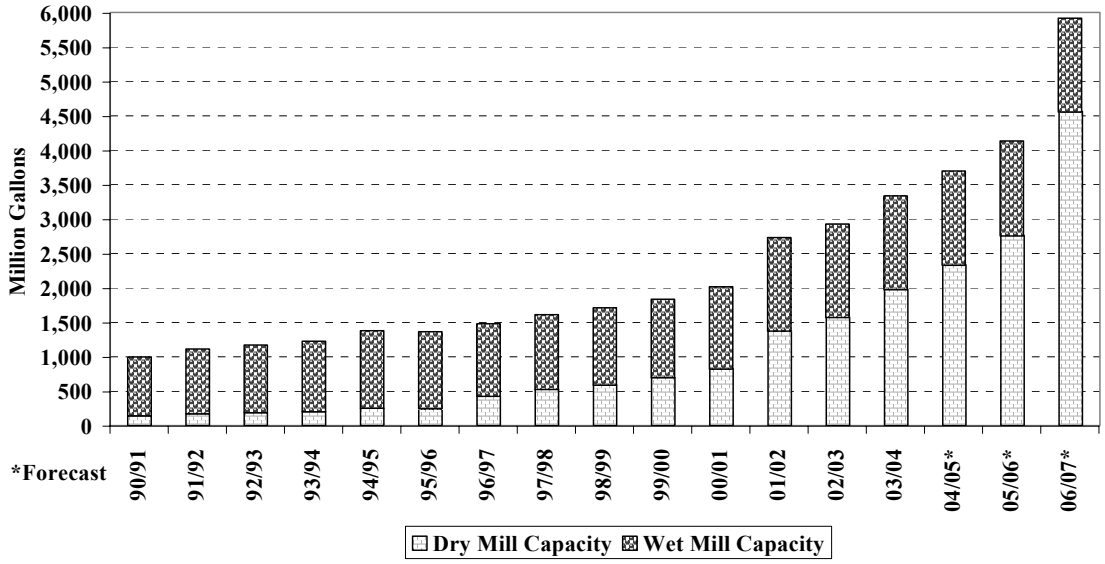
Passage of the Energy Bill, particularly the Renewable Fuel Standard, provides a strong incentive for further expansion of the ethanol industry, but profitability for individual ethanol producers remains dependent on conditions in both the feedstock (especially corn) and ethanol markets. Ethanol prices recently recovered after dipping below gasoline prices for the first time in early 2005. In recent weeks ethanol prices moved above gasoline prices but only slightly, and ethanol margins recovered after dipping during the recent price slump. The most recent capacity survey indicates a total of 3,962 million gallons capacity, with facilities still under construction/expansion likely to add another 1,019 million gallons (Chart 6).

Current Situation and Outlook

- Ethanol production in marketing year 2005/06 is expected to increase 10.5% to 4.0 billion gallons, and to expand corn use for ethanol production to 1,450 million bushels, 11.5% above the previous year. Ethanol production in June was 302 million gallons, a 7 million gallon decrease from the previous month. June's production was up 8.3% from June 2004.

- The early outlook for 2006/07 is for ethanol production to increase 15% to 4.6 billion gallons. Corn used for ethanol production will increase 15.4% to 1,673 million bushels.

Chart 6: US Dry and Wet Mill Capacity



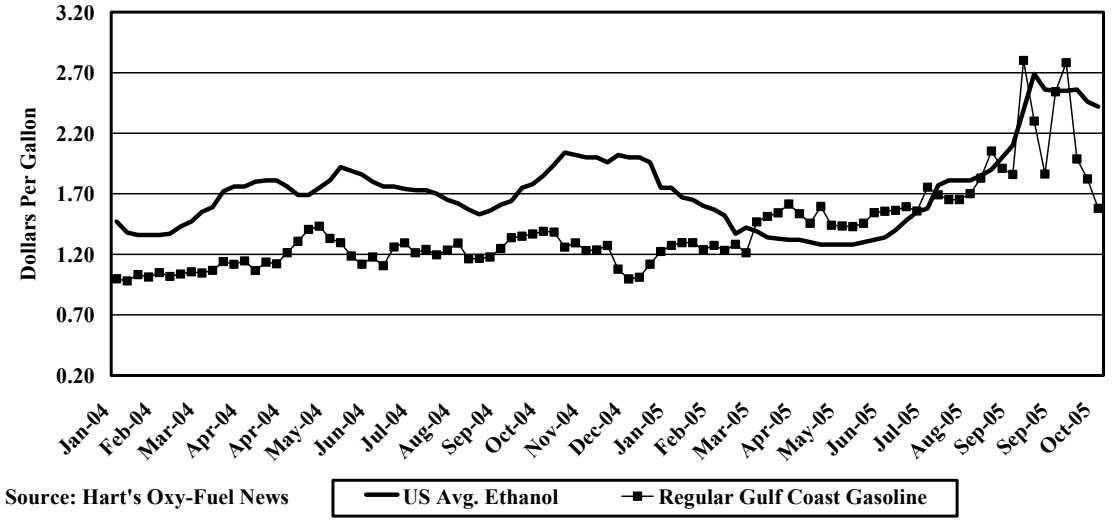
- The industry is expected to approach full capacity in 2005. There are 91 ethanol plants now in production with an estimated annual production capacity of 4.16 billion gallons, but the 21 plants under construction would bring total capacity to 5.40 billion gallons.

- Currently 44 of the 91 ethanol plants across the United States are farmer-owned, while 5 of the 21 plants under construction are also farmer owned. The largest producing states are Iowa, Illinois, Nebraska, South Dakota, and Minnesota.

- The average ethanol price rose above $2/gallon in August and has remained above $2.40/gallon throughout October (Chart 7). Ethanol prices averaged $1.73 in 2004.

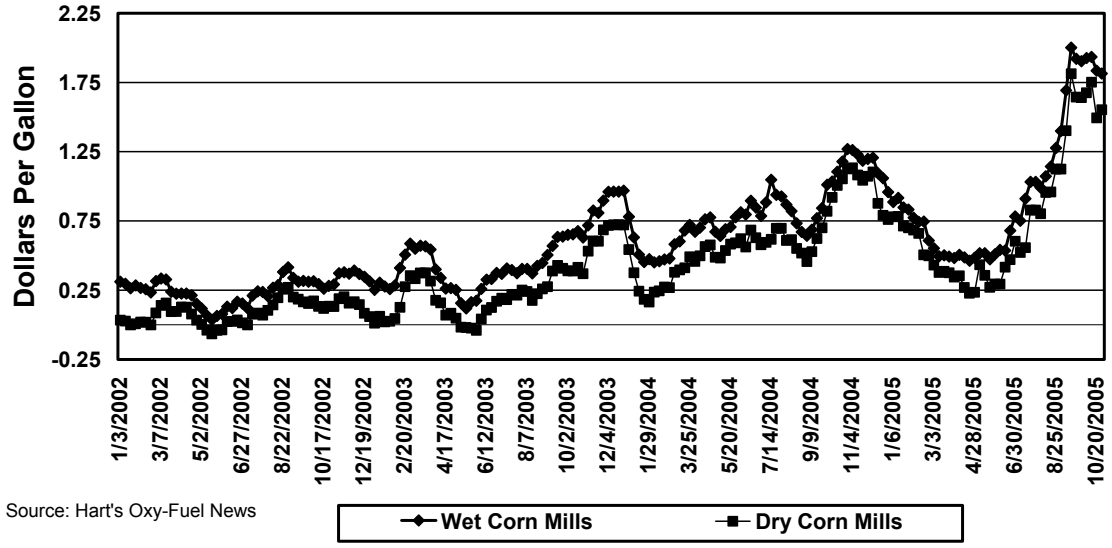
- Wet and dry mill margins recovered from 48¢/27¢ in April to 92¢/68¢ in July. Margins surged above $1.25 September due to high fuel prices resulting from Hurricane Katrina. However, fuel prices have already begun to fall as shut-in oil and refinery capacity comes back on line, which will put downward pressure on ethanol prices.

Chart 7: Ethanol and Regular Gasoline Prices



Source: Hart's Oxy-Fuel News

Chart 8: US Midwest Calculated Ethanol Margins



Source: Hart's Oxy-Fuel News

Ethanol Production Resources by State

For most of the time period since the 1996 Farm Bill, which eliminated set-aside annual land idling programs and gave farmers freedom in allocating their acreage in response to market signals, corn supplies have been plentiful and prices have been moderate, at times, even inexpensive. Ethanol production is widely viewed by farm groups as a means to increase the local price of corn (i.e. the "basis") by expanding the number of competing uses for corn, and hence the demand in local markets. Given the large fixed investment even for a relatively modest-sized ethanol facility, it is imperative that the facility have access to a consistent and reliable feedstock supply in order to maintain production at an optimal level so that unit production costs can be minimized and remain competitive. Therefore, corn demand by ethanol producers—as with all industrial processors—is quite inelastic, especially relative to export markets, or to a smaller extent the livestock sector, which tends to have a greater ability to adjust its usage over time in response to local supply and price conditions.

Hence, feedstock supply and price are critical determinants of the overall competitiveness of individual ethanol facilities, within the larger context of the market and policy conditions that might make the ethanol market attractive at the national level. Indiana ranks fifth in US corn production, with 2004 production exceeding 929 million bushels (its record highest production) harvested from over 5.5 million acres (Table 3). These large supplies would appear to make Indiana an attractive location for an expanding ethanol sector, but as Table 4 shows, Indiana's ethanol production capacity, at 102 million gallons per year from its single plant, places it ninth among the top producing states, with less than 20% the output capacity of Minnesota, the fourth largest corn producing state. Furthermore, South Dakota, with annual corn production of less than 60% that of Indiana, boasts ethanol production capacity of more than 4 times that of Indiana.

Table 3: Top 10 Corn Producing States

	Acreage		Production		
State	2004	2005	2003	2004	2005*
	1,000 Acres		*1,000 Bushels*		
IA	12,400	12,650	1,868,300	2,244,400	2,074,600
IL	11,600	11,950	1,812,200	2,088,000	1,493,750
NE	7,950	8,100	1,124,200	1,319,700	1,263,600
MN	7,050	7,000	970,900	1,120,950	1,085,000
IN	*5,530*	*5,650*	*786,940*	*929,040*	*819,250*
SD	4,150	3,900	427,350	539,500	468,000
OH	3,110	3,220	478,920	491,380	434,700
MO	2,880	3,000	302,400	466,560	297,000
KS	2,880	3,100	300,000	432,000	387,500
WI	2,600	2,800	367,650	353,600	364,000

*Forecast
Source: USDA/NASS

Table 4: Ethanol Production Capacity Ranked by State, July 2005

Rank	State	Ethanol Production Capacity (Million Gallons Per Year)
1	Iowa	1,632.5
2	Illinois	816.0
3	Minnesota	523.6
4	Nebraska	523.0
5	South Dakota	458.0
6	Wisconsin	210.0
7	Kansas	164.5
8	Missouri	105.0
9	*Indiana*	*102.0*
10	North Dakota	83.5
11	Tennessee	67.0
12	Michigan	50.0
13	Colorado	43.5
14	California	31.4
15	New Mexico	30.0
15	Texas	30.0
16	Kentucky	27.0
17	Wyoming	5.0
18	Ohio	3.0
19	Washington	0.7
	United States Total	4,905.70

Source: Compiled from Renewable Fuels Association Data

Clearly, corn supplies only define part of the state or regional competitiveness of the ethanol sector. Competing markets for existing corn supplies are also critical, especially as these competing uses can impact the local corn price independent of demand by the ethanol sector. The primary markets for corn produced throughout the Midwest include livestock feeding; ethanol production; other industrial corn processing including HFCS, starches, and related compounds (generally referred to as wet milling), dry milling for food use, and exports. We estimate the size of the markets within Indiana as follows:

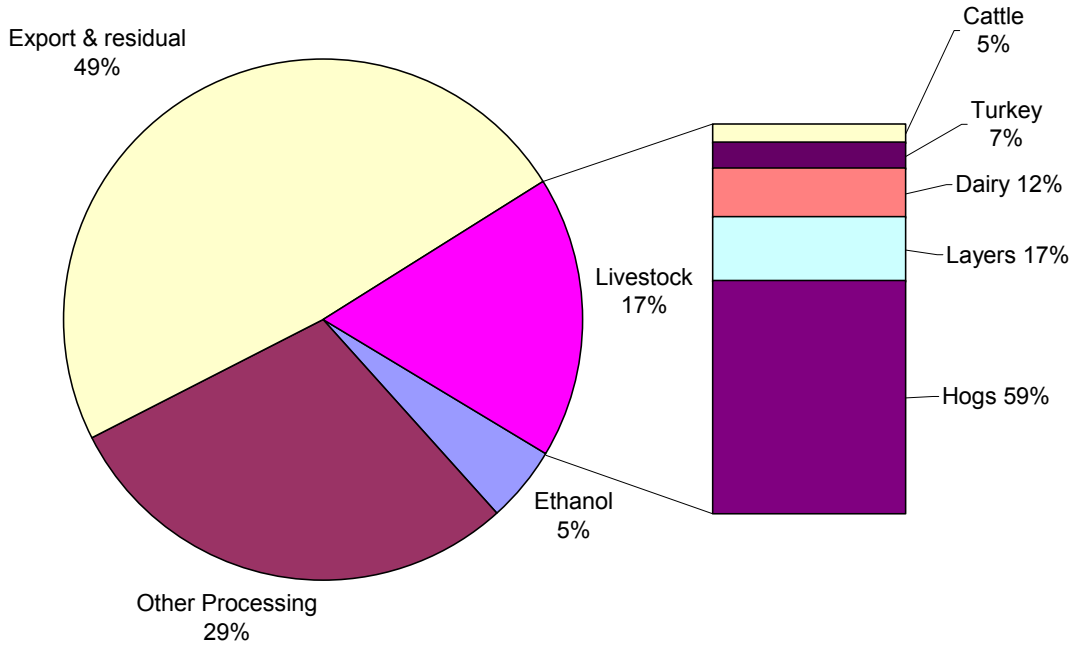
- **Total corn production** is estimated as the average Indiana corn production reported by USDA/NASS over the years 2000-2004.
- **Indiana livestock feed use** is estimated for the major species based on 2004 USDA/NASS estimates of hog, turkey, cattle and egg production, along with dairy cow inventories, to which standard feed conversion ratios and typical corn feeding rates are applied for each species. The result is an estimate of the total 2004 corn use by the Indiana livestock sector.
- **Indiana corn use for ethanol** is estimated based on an industry-standard conversion rate of 2.6 gallons of ethanol from each bushel of corn, applied to Indiana's current ethanol capacity of approximately 102 million gallons per year.
- **Corn use for other processing**, including industrial wet milling and dry mill food use, is estimated based on Informa's proprietary estimates of annual corn grind for what we believe to be all dry mill and wet mill corn plants located in Indiana. Wet mills usually consist of large national or multi-national firms such

as Cargill, Tate & Lyle Staley, and ADM; while dry mills engaged in other processing can include some multi-national firms such as Cargill, but also include smaller firms operated locally by such companies as Wilson's Corn Products, Nunn Milling, and Agricor, Inc.

- The **residual and export** category is corn use unaccounted for by the livestock, ethanol, industrial, and food use markets estimated above. Informa assumes corn supplies not explicitly accounted for by the main consumption categories defined above either leave the state or, possibly, are added to stocks. Although stocks can vary considerably year-to-year, they tend to be relatively stable over time and are therefore not considered explicitly in this exercise. Hence, the export and residual category is primarily composed of corn that leaves the state, either to serve international or out-of-state domestic markets.

Chart 9 shows an estimate of the size of the competing markets for corn produced within Indiana, based on the procedure outlined above.

Chart 9: Indiana Markets for Corn, Major Uses by Sector



Ethanol production in Indiana currently consumes about 5% of annual corn production within the state, but other forms of food and industrial processing capture another 29% of the crop, so that the entire processing sector accounts for over one-third (34%) of the volume of corn annually produced and marketed in the state. The livestock sector maintains an important market share of about 17%, the majority of which (62%) is used to feed the state's large base of hog production.

Adding ethanol capacity beyond the existing 102 million gallons annually produced would necessarily require either new corn production within the state to supply the new

markets while maintaining existing markets, or a corresponding reduction in use by some or all of the existing markets within the state. Most likely, new ethanol capacity would create some combination of greater corn acreage (as higher and more dependable prices in the geographic market near the facility(s) attract acreage away from other crops like soybeans) and lower use by competing users, with export markets, and to a lesser extent the livestock sector, most vulnerable for reduced markets.

Other (non-ethanol) processing facilities will maintain a rather inelastic demand for corn, owing to their need to maintain a large volume of throughput to keep overall production costs low. While this sector could face higher prices for corn in local markets, and perhaps a need to attract corn from more distant locations, relatively favorable margins and the fixed investment in existing facilities makes it unlikely that any but the smallest and/or highest cost processing plants would be severely impacted by the resulting increase in local corn basis. That said, there are several relatively small dry-mill corn processing facilities within Indiana, and while their cost structure is unknown, any plant that might be forced to compete directly with a new ethanol facility for a relatively fixed supply of corn in the local market could find that they are no longer competitive in their own sector, forcing a decision to either relocate or shut down.

Some of the corn required to supply an expanded ethanol sector could be attracted away from the livestock sector. Unlike firms in the processing sector that are designed to create food and industrial products specifically from corn, livestock producers have some ability to modify their feeding rations in response to changing prices and availability of corn, soybeans, forages and other feed components. And, the by-products of ethanol production can in some cases replace or reduce direct corn use in some rations. However, to the extent that greater demand for corn for ethanol production provides any upward pressure on the price of corn in existing feeding regimes, feed costs will increase either directly from higher costs of the corn component of feed rations or from the necessity of replacing some corn in existing rations with the next best feed component other than corn.

Whether higher feed costs could reduce Indiana's overall competitiveness in livestock production is unclear. On the one hand, developments over the last 10 years in the hog sector have demonstrated that this industry is extremely mobile, as production has rapidly expanded in areas traditionally not widely associated with hog production, such as the Southeast US and several Western States, at the direct expense of the Midwest. This suggests that over time higher feed costs could discourage future investment in livestock production and perhaps even force some existing producers to exit the industry or relocate. But on the other hand, much of the recent geographic restructuring has been toward regions relatively distant from the bulk of the grain supply, suggesting that other factors, such as the ability to develop integrated supply chains, environmental factors, and local acceptance of hog production facilities are perhaps at least as important as feed costs in determining the competitiveness of livestock production across states.

Although chart 9 above suggests that Indiana has a substantial corn surplus from which to feed an expanding ethanol sector (with only slightly more than one-half of corn production used within the state, the balance allocated to residual and export markets), it

is useful to compare the nature of the markets in Indiana with those of other major corn producing states to get a more complete picture of Indiana's relative competitiveness in ethanol production. Using the same procedure outlined above to estimate Indiana's corn supply and use, corn production and market patterns for the next four largest corn states (Minnesota, Nebraska, Illinois and Iowa) were estimated for 2004 and are illustrated in figure 2. Each of these states has been considerably more aggressive than Indiana in expanding its ethanol production in recent years.

To compare how the aggressive expansion of ethanol production in Minnesota, Nebraska, Illinois and Iowa might have impacted competing users of corn in each state (such as the livestock sector and exports), a similar series of charts is constructed for 1994, based on corn production and use during that period. These charts are presented in Figure 3. Figures 2 and 3 suggest that the rate of expansion of ethanol production in particular states and regions reflects not only the extent to which state efforts and initiatives actively promote ethanol production, but also the size and importance of competing markets for corn within the state. Several points are worth noting from Figure 2:

- When production of ethanol is combined with all other forms of industrial corn processing (i.e. wet and dry milling) in each of the top five corn states, Indiana's current processing capacity (at 34% of corn production) actually exceeds that of the other states, including Nebraska and Minnesota which have been extremely aggressive at building ethanol production capacity.
- The export and residual category reflects not only the amount of "surplus" corn available for expanded ethanol production, but also the relative cost of transporting corn to key markets outside the state. For instance, Illinois' superior access to the inland waterways gives it a clear advantage in supplying corn deficit states in the Southern US and foreign markets via gulf ports. Similarly, Indiana and Nebraska, each respectively on the eastern and western edges of the traditional corn-belt, are important suppliers to deficit states on either coast of the United States. Minnesota, on the northern edge of the inland waterway and far from US corn deficit regions, is much less competitive in supplying markets outside the state so has a high incentive to develop in-state markets.
- Livestock is an important user of corn in all states examined, but the mix of livestock species in the state can impact the extent to which corn can be diverted to other uses with minimal impact on the existing livestock sector. Hogs and poultry tend to have the most corn-rich diets of all major livestock species, with few viable substitutes in any significant quantity. Beef cattle have corn-rich diets but only during their final months of weight gain, and dairy cattle often have corn rich diets but dairymen can be quite resourceful at substituting a range of other carbohydrate sources, including wheat, oats, soybean hulls, etc. Furthermore, dried distiller's grain with solubles (DDGS), a byproduct of the dry-mill ethanol process, is much better suited for use in ruminant feed than in either hog or poultry feed. Therefore, Nebraska and Minnesota, with relatively large cattle and dairy industries, respectively, maintain a natural advantage in diverting some corn production to ethanol use at a somewhat reduced risk to available supplies for the more corn-dependent hog and poultry sectors.

Figure 2: Corn Use by Sector in 2004, Major Producing States

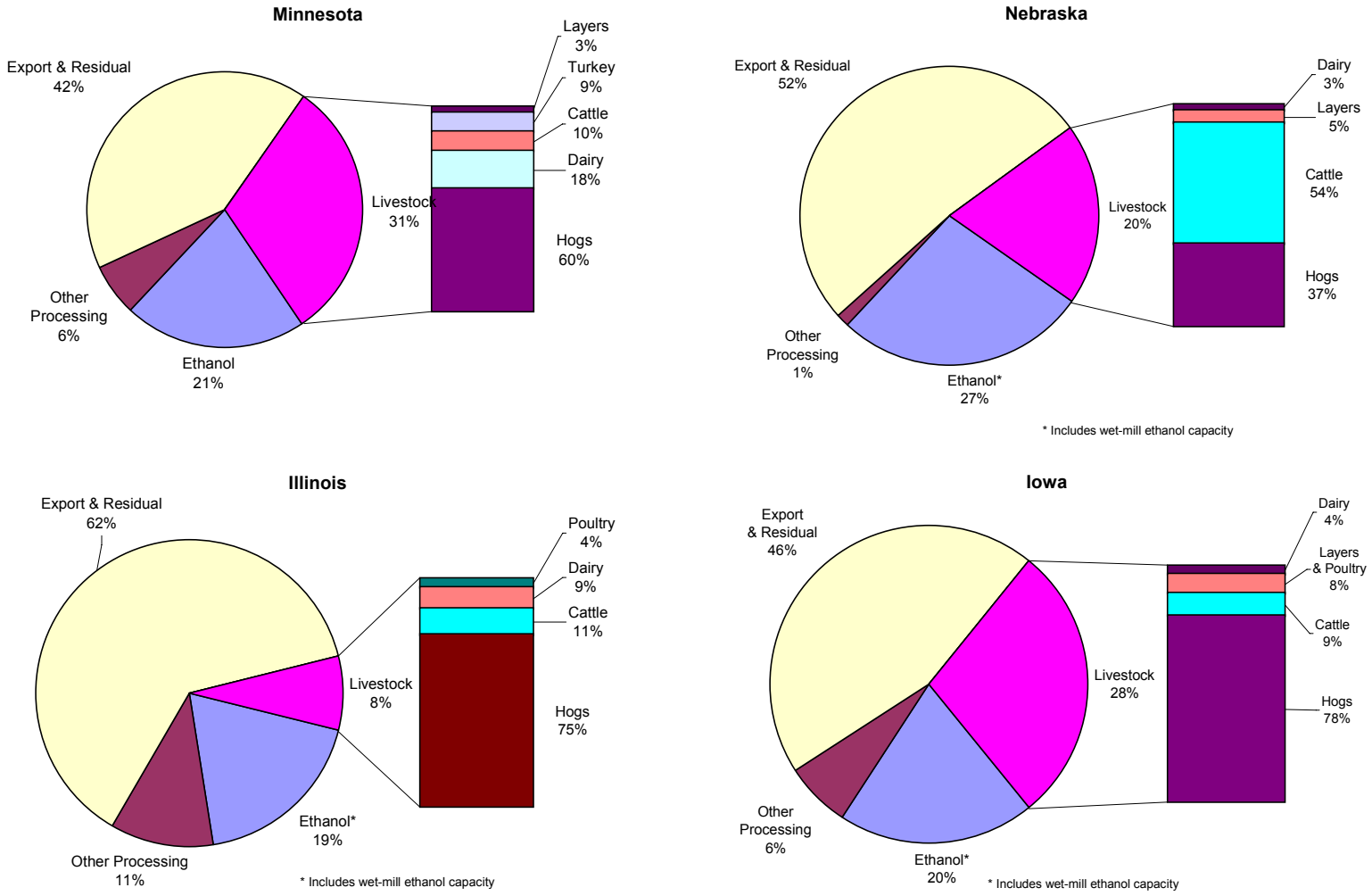
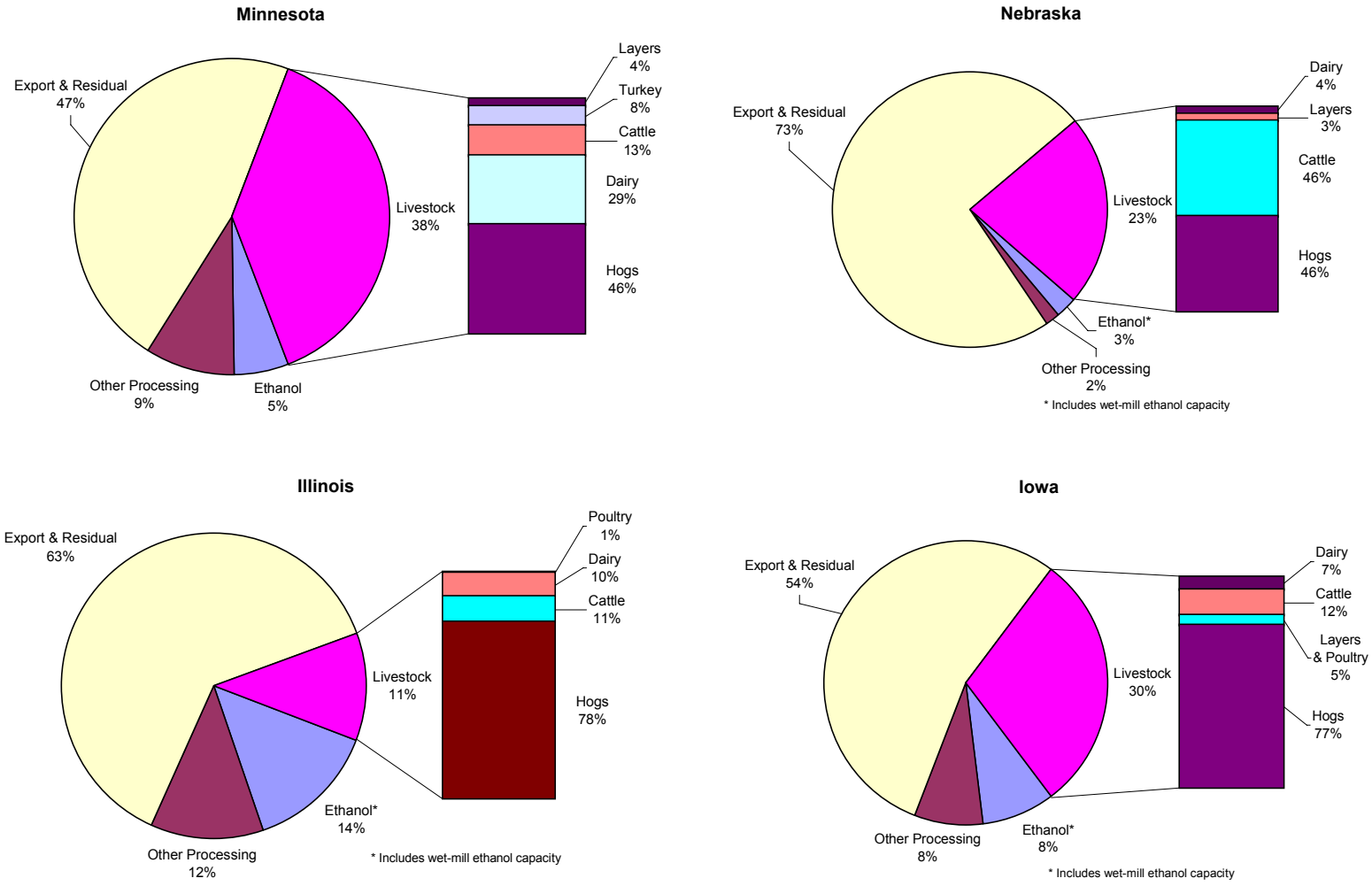


Figure 3: Corn Use by Sector in 1994, Major Producing States



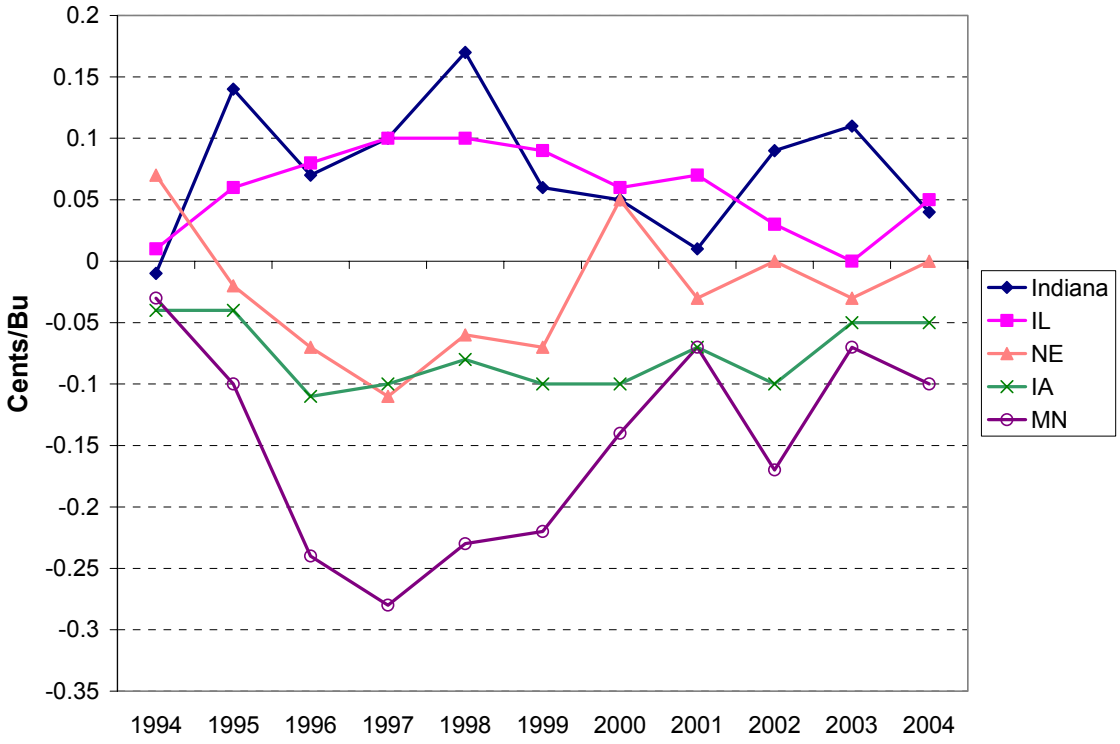
The charts in Figure 3 show corn use patterns for the same states in 1994, allowing an assessment of how the expansion of the ethanol industry in these states might have affected the supplies available to other sectors[1]. As Figure 3 shows, in each state that experienced rapid growth in ethanol production, the share accounted for by both the export and residual category and livestock use declined somewhat. However, the underlying data suggest that in fact, in most cases corn production expanded in direct relation to the increased demand by the ethanol sector, limiting the extent to which existing markets for corn faced lower supplies.

In Nebraska, corn use for ethanol expanded by over 132 million bushels from 1994-2004, but corn production expanded by nearly 106 million bushels. Of the difference, about 8 million fewer bushels were fed to the livestock sector in 2004 (largely reflecting a decline in hog feeding), with the remainder drawn out of exports. But in both Minnesota and Iowa, corn production over this period actually increased slightly beyond what was needed to supply the larger ethanol sector, and as a result livestock use increased as well (in levels, if not in share of total use).

Finally, the extent to which a particular state or region maintains a competitive advantage for ethanol production given its existing and potential corn supplies is reflected to a large extent in the local price of corn. Although corn is only one of many inputs required in producing ethanol (others including fuel and electricity, labor, capital, etc.), it is certainly one of the most important and perhaps one of the most variable both over time and across geographies. Plus, since the price in any market is determined by the demand for corn among all competing users given available supplies, the local price is a unique and powerful indicator of the extent to which corn supplies can be easily allocated among competing uses, as well as the relative cost of producing ethanol in different locations. Chart 10 illustrates the state average farm price of corn in the top five corn-producing states, relative to the US average price for corn in from 1994 to 2004. While this is not a true measure of the corn "basis" in each of these states (which is typically defined as the difference between local market prices and corresponding prices at the Chicago Board of Trade or other central exchanges), it does provide similar information for comparing market conditions across regions, in this case entire states.

[1] The estimates were based on similar data as was used in Figure 2, with total corn production for each state reflecting average levels from 1992-1994, estimated ethanol production by state in 1994, and USDA estimates of livestock production in 1994. Informa does not have historic data for the "other processing sector," but since this sector tends to change very slowly over time, we assumed that its capacity in 1994 was similar to 2004 levels.

Chart 10: Farm Price for Corn, Relative to US Average



Over the previous 10-year period, farm prices for corn in Indiana averaged somewhat above the US average, and well above the averages for Minnesota, Iowa, and even Nebraska. Although many factors can impact local market prices, the price patterns in chart 10 are consistent with many of the state market conditions discussed using chart 9 and figure 2, above. For instance, Illinois' strong advantage in supplying export markets is reflected in the increasing relative prices in that state during the mid-1990's when export demand was high and growing. Minnesota, on the other hand, was experiencing worsening prices over much of this period, which began to improve in more recent years consistent with the expanding ethanol industry in that state. A similar pattern of recently stronger prices is evident for Nebraska, which also greatly expanded its ethanol industry during this period.

The tendency for corn prices in Indiana to be relatively strong in recent years, remaining above many competing states that have aggressively expanded ethanol production, presents a challenge for companies interested in siting new ethanol plants in Indiana. The higher expected costs of corn relative to either existing ethanol facilities in other major corn states or perhaps even new plants in those states, could lead to higher relative costs of production, and reduced margins if the difference cannot be made up either in improved production efficiencies (using less corn to produce equivalent amounts of ethanol) or higher market prices for ethanol and its byproducts. However, local corn prices in within-state markets can also vary considerably based on local supply and demand conditions, so it is quite possible that even in states like Indiana with relatively high average farm prices, individual markets within the state could have a lower (i.e.,

more favorable) basis for supplying an ethanol industry. Therefore, ideally each local market should be explored individually to gauge its potential ability to supply an ethanol facility at competitive prices.

Ethanol By-Product Markets

To be profitable, most ethanol facilities require favorable markets not only for ethanol, but for the by-products of ethanol production that typically are sold into the feed industry. In the dry-mill process for producing ethanol, the starch portion of the corn kernel is largely converted to ethanol, while the remaining material is referred to as distillers grains and is sold primarily as a livestock feed. Usually, distillers grains are dried to yield dried distillers grains (DDG), or dried distillers grains with solubles (DDGS) if solubles in the thin stillage are added back to the grains at drying. The solubles in the thin stillage may also be partially or totally dried to make condensed distillers solubles (CDS) or dried distillers solubles (DDS), respectively. Of these co-products, DDG and DDGS are the most commonly used, probably because of ease of handling, storage, and shipping.[2] Since DDGS is becoming the most common form in the market, it will be used in this report as the "common denominator" of this group of co-products.

The production of distillers grains in the US has grown dramatically over the last decade, and even just the last few years. In the early 1990s, just over 1 million tons (short tons) of distillers grains were produced according to Informa estimates. From the early 1990s to crop year 2000/01, production of distillers grains roughly doubled, reaching 2.2 million tons, as ethanol production had resumed its long-term rise after the drop that had occurred in the summer of 1996, when corn supplies became tight and prices increased. Given that a large majority of the tremendous expansion of US ethanol capacity over the last few years has come through the construction of dry mills, Informa estimates that the production of distillers grains rose to 6.5 million tons in 2003/04. These volumes are expressed in terms of distillers dried grains with solubles (DDGS) equivalent.

DDGS is a middle-protein feed with a minimum crude protein content of roughly 30% for newer facilities (for older facilities, the crude protein content is roughly 27%). Traditionally the primary market outlet for distillers grains has been in feed rations for beef and especially dairy cattle, as its composition limits the inclusion rate in feed for monogastric animals (most importantly hogs and poultry). The high ruminally undegradable protein content (30.4% crude protein, of which 52% is ruminally undegradable) of DDGS makes it particularly suitable for feeding to dairy cattle. As such, the theoretical nutritional value attributed by researchers to DDGS tends to be highest for dairy cattle compared to beef cattle and other species.

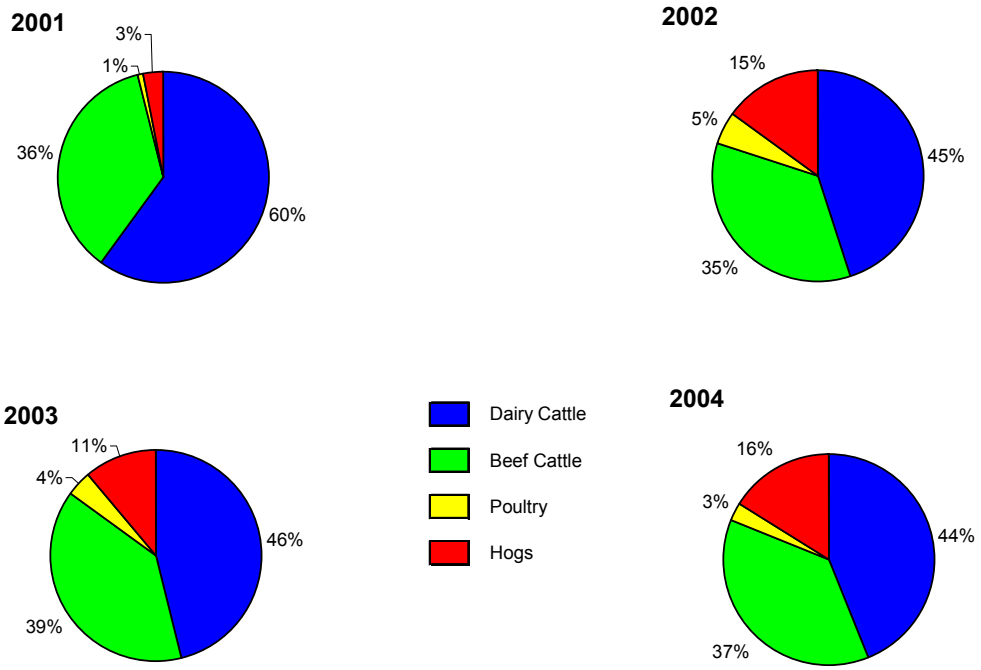
Even after the considerable increase in distillers grain production that has occurred as a result of the expansion of the ethanol industry over the last few years, a large majority of distillers grains consumption is still accounted for by dairy and beef cattle. According to

[2] Jean-Marie Akayezu, James G. Linn, Summer R. Harty, and James M. Cassady, "Use of Distillers Grains and Co-Products in Ruminant Diets," Presented at the 59th Minnesota Nutrition Conference, Bloomington, MN, September 1998 (http://www.ddgs.umn.edu/proceedings-dairy/1998nutrconf.pdf).

industry estimates, in 2004 dairy and beef cattle accounted for 81% of the distillers grains consumed domestically (Figure 4).

Still, both the percentage share and the absolute volume of distillers grains consumed for by monogastric animals have increased significantly in recent years. This is especially the case for the swine market, which accounted for less than 4% of distillers grains consumption in 2001 but grew to 16% of the total by 2004. This is due not only to efforts by marketing firms to broaden sales of distillers grains but also to an initiative by certain animal scientists to perform the basic feeding research necessary to convince hog operations (and their nutritionists) that distillers grains can be a useful and economical feed ingredient in swine rations.

Figure 4: US Consumption of Distillers Grains by Species



Source: Steve Markham, Commodity Specialists Co., via G.C. Shurson, Department of Animal Science, University of Minnesota, "Supply and Demand of US DDGS," presented in South Korea, March 7-11, 2005.

The level of consumption in poultry has been increasing as well, estimated at 3% of domestic consumption in 2004. However, the volume consumed by poultry has been constrained by the single-digit inclusion rates recommended by nutritionists, the lower perceived value in poultry feed versus cattle rations and the fact that broiler operations are located outside of the main US ethanol production region.

Cattle, especially milk cows, tend to consume far more feed per day than hogs or broilers. Furthermore, maximum inclusion rates of DDGS cited in published reports from feeding trials conducted by nutritionists tend to be considerably higher in cattle than monogastrics, at 35% for cattle on feed and 30% for dairy cows, compared to 15% for hogs and 10% for broilers. (There is some variation in these recommendations based on the stage in the

animal's life cycle.) However, in practice, typical inclusion rates are considerably lower than the maximums that nutritionists indicate are allowable. Typical rates are 11% of the ration for cattle on feed, 12% for dairy cattle, 11% for hogs and 8% for broilers.

While the Indiana and the Eastern Corn Belt is not the most concentrated production area in the US for either dairy or beef cattle (see Figures 5 and 6), it nevertheless has significant dairy cow inventory and is in relatively close proximity to large dairy cow concentrations in Wisconsin, Pennsylvania, New York, and other Eastern markets. A key consideration for profitable ethanol production in Indiana will be maximizing the feed value of DDGS, whether through low-cost transport to feed-deficit regions within or outside the state, or through research that improves the ability to feed DDGS to hogs or other species.

Figure 5: US Milk Cow Inventories, 2002

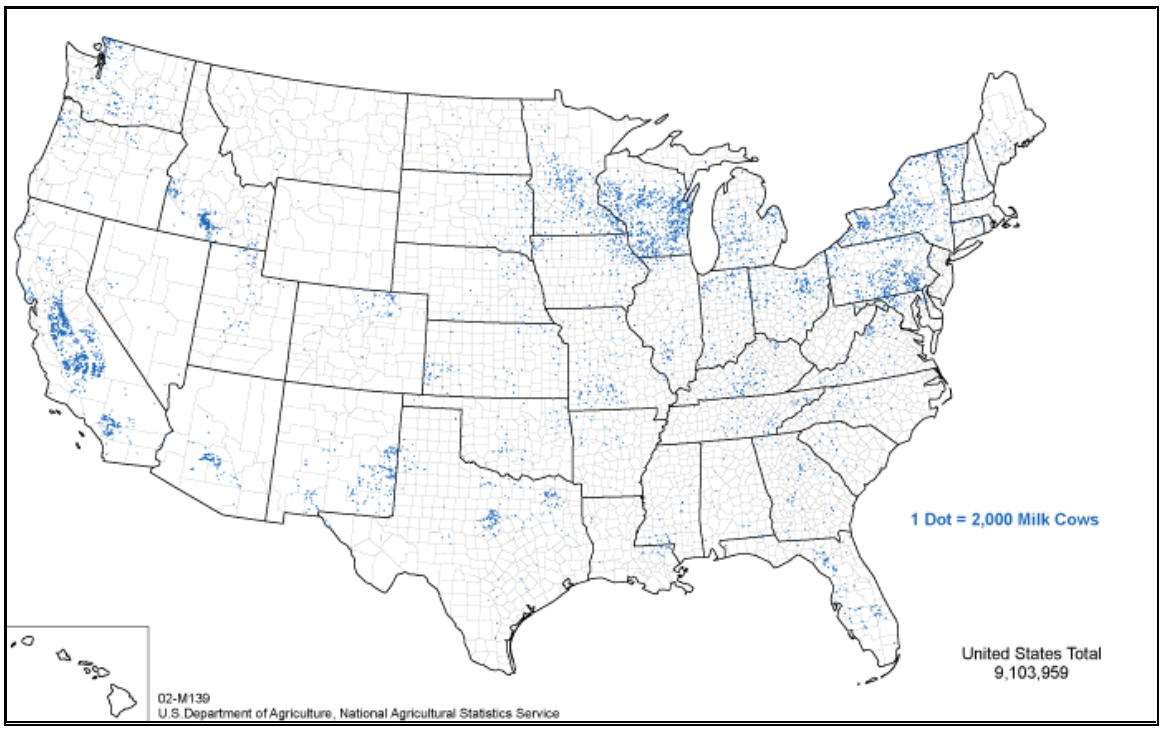
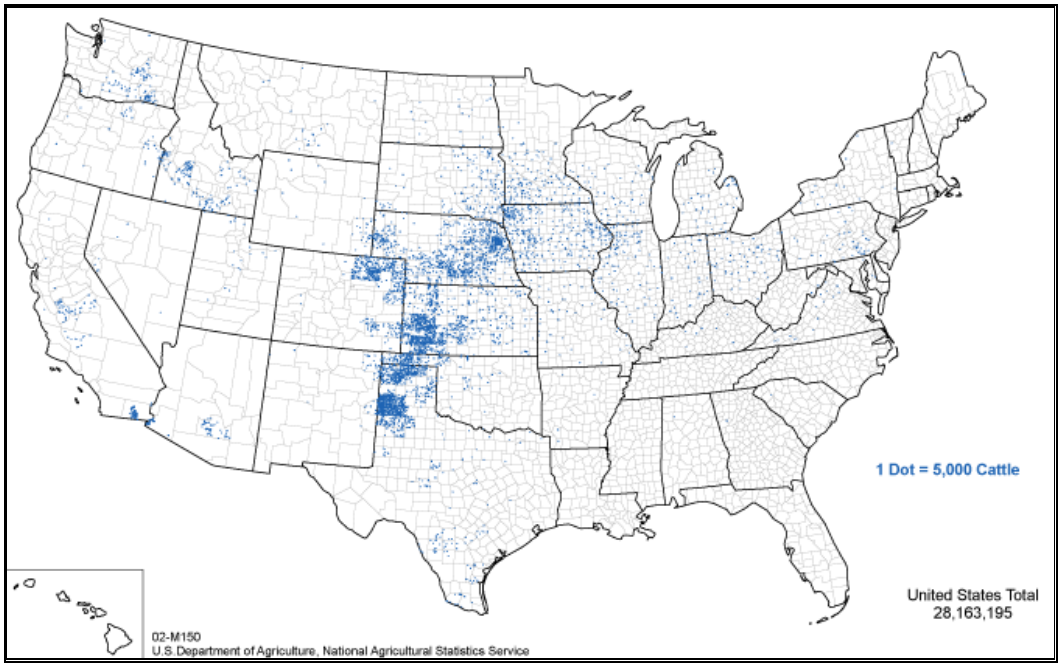


Figure 6: US Marketings of Cattle on Feed, 2002



As an indication of the relative size of the DDGS market in Indiana and competing states, potential in-state consumption of DDGS is estimated for Indiana and the four other major ethanol-producing states examined throughout this report. Using a similar procedure as was employed to estimate corn consumption by livestock species above, in-state use of DDGS in feeding rations was estimated for each major livestock species in each states based on both maximum DDGS inclusion rates and more realistic inclusion rates in those rations where DDGS is typically included.

Based on maximum inclusion rates, the consumption of DDGS in Indiana could be as high as 928,000 tons per year, assuming all livestock in the state received the maximum feeding ration (see table 5). A more typical inclusion rate for each species still suggests an in-state DDGS market of over 570,000 tons per year, but even this could be optimistic considering that all livestock producers might not feed DDGS even at standard rates. However, a 100-mmgy ethanol facility (similar in size to the one currently located in Indiana) typically will produce roughly 315,000 tons of DDGS per year, still below the expected in-state livestock use under standard inclusion rates. Hence, Indiana has the potential to consume all DDGS produced in state even if existing ethanol capacity is increased by about 80%, or an additional 80 million gallons of ethanol capacity. In-state DDGS use would be expected to increase even further if inclusion rates expand toward what is currently assumed to be maximum levels, suggesting that efforts to improve producer acceptance of DDGS as a feed source—through education as well as research to improve palatability, quality, consistency, and feeding value—are an important and potentially valuable focus of policy efforts.

Table 5: DDGS Market Potential, Indiana and Major Ethanol States

State and Species	2004 Livestock Inventory	Maximum Inclusion Rate	Maximum DDGS Consumption	Typical Inclusion Rate	Estimated DDGS Consumption[1]
	1,000 Head	*%*	*Tons*	*%*	*Tons*
Indiana					
Dairy	150	30	221,738	12	88,695
Cattle on Feed	105	35	109,578	11	34,439
Hogs	3,150	15	451,582	11	331,160
Poultry	--	10	145,435	8	116,348
Total DDGS Consumption			928,333		570,642
Iowa					
Dairy	193	30	285,302	12	114,121
Cattle on Feed	950	35	686,167	11	215,652
Hogs	16,100	15	2,261,308	11	1,658,293
Poultry	--	10	220,459	8	176,367
Total DDGS Consumption			3,453,236		2,164,433
Minnesota					
Dairy	473	30	699,212	12	279,685
Cattle on Feed	310	35	454,199	11	142,748
Hogs	6,600	15	973,451	11	713,864
Poultry	--	10	169,324	8	135,459
Total DDGS Consumption			2,296,186		1,271,756
Illinois					
Dairy	107	30	158,173	12	63,269
Cattle on Feed	200	35	238,717	11	75,025
Hogs	3,950	15	544,443	11	399,259
Poultry	--	10	25,781	8	20,625
Total DDGS Consumption			967,114		558,178
Nebraska					
Dairy	61	30	90,173	12	36,069
Cattle on Feed	2,450	35	1,870,295	11	587,807
Hogs	2,850	15	431,779	11	316,638
Total DDGS Consumption			2,392,246		940,514

1. Assumes all livestock receive DDGS at a "typical" inclusion rate. However, in reality DDGS is likely not included in all feed rations by all producers, so even these estimates likely exceed the actual volume consumed.

Source: USDA (livestock numbers) Informa (calculations).

Despite the relatively large potential market for DDGS in Indiana, the markets in Nebraska, Minnesota and Iowa are still considerably larger, which likely gave those states an early advantage in profitably developing their own markets for DDGS. And, as mentioned above, a significant proportion of DDGS can be feed to dairy and beef cattle in Minnesota and Nebraska, providing reduced competition for corn available to supply their respective hog sectors. Unless DDGS feeding rates for swine and poultry are dramatically improved, potential DDGS demand in states with large swine and poultry sectors (like Indiana) will always be limited.

Issues to Consider For Expanding Biofuels Production in Indiana

- Availability of adequate feedstocks. Corn-derived ethanol is by far the predominant renewable fuel product produced today using agricultural inputs. A dry-mill ethanol facility capable of producing 40 million gallons per year (about the average size of producer-owned plants currently located throughout the corn belt) would require a dedicated supply of about 14.3 million bushels of corn per year, preferably sourced within about a 100-mile radius from the facility. Indiana's total average corn production between 2002-04 was about 748 million bushels, suggesting that a 40 million gallon facility would consume less than 2% of the state's total historic production, but the actual impact on local markets would depend on where the plant is sited relative to existing corn supplies and the exiting demand from other uses, including the existing 100 million gallon facility located in South Bend.
- Competition for Existing Feedstocks. With corn as the primary feedstock, a sharp increase in ethanol production could have an adverse impact on livestock feed costs especially for hogs, which depend on a heavily corn-based feed ration. Increasing domestic demand for corn can also make corn less competitive in export markets—with long-term consequences of increased corn production by competing suppliers on world markets.
- Markets for Ethanol Byproducts. A 40 million gallon ethanol facility would be expected to produce roughly 126,000 tons of DDGS per year. To be competitive, an ethanol facility must be able to receive a competitive price for DDGS in addition to the ethanol it produces. DDGS can be a valuable feed ingredient, but it is ideally suited to cattle and other ruminants, with maximum inclusion rates typically of about 35% for cattle, 30% for dairy cows, and only about 15% for hogs and 10% for broilers. Although Indiana has a large and growing dairy industry, it is unclear whether this industry could absorb the volume of DDGS produced from an expanded ethanol industry at prices that still provide a reasonable return to the ethanol facility. Hence, markets outside Indiana should be considered, including the transportation costs of reaching those markets.
- Future Competition from Imports. The domestic ethanol industry is moderately protected from imports by a 52¢/gallon tax on imports. However, even with these import protections, ethanol produced directly from sugarcane in developing nations such as Brazil can at times be imported at competitive prices, due especially to the lower cost of producing ethanol from sugarcane compared to corn. DR-CAFTA could increase access by those nations to the US ethanol market as well, which would also be produced using sugarcane. The result would not necessarily supplant current US ethanol production, but restrict future growth prospects by introducing fierce global competition from other low cost producers. Currently, the support for the excise tax exemption for ethanol is strong, enjoying support from outside the agricultural sector due to high gasoline prices. The fact that high gasoline prices could allow ethanol to be priced competitively even without the exemption is not an issue because gasoline prices are expected to fall in the near future. If oil prices were to stay high, however, the need for the excise tax exemption could be revisited.

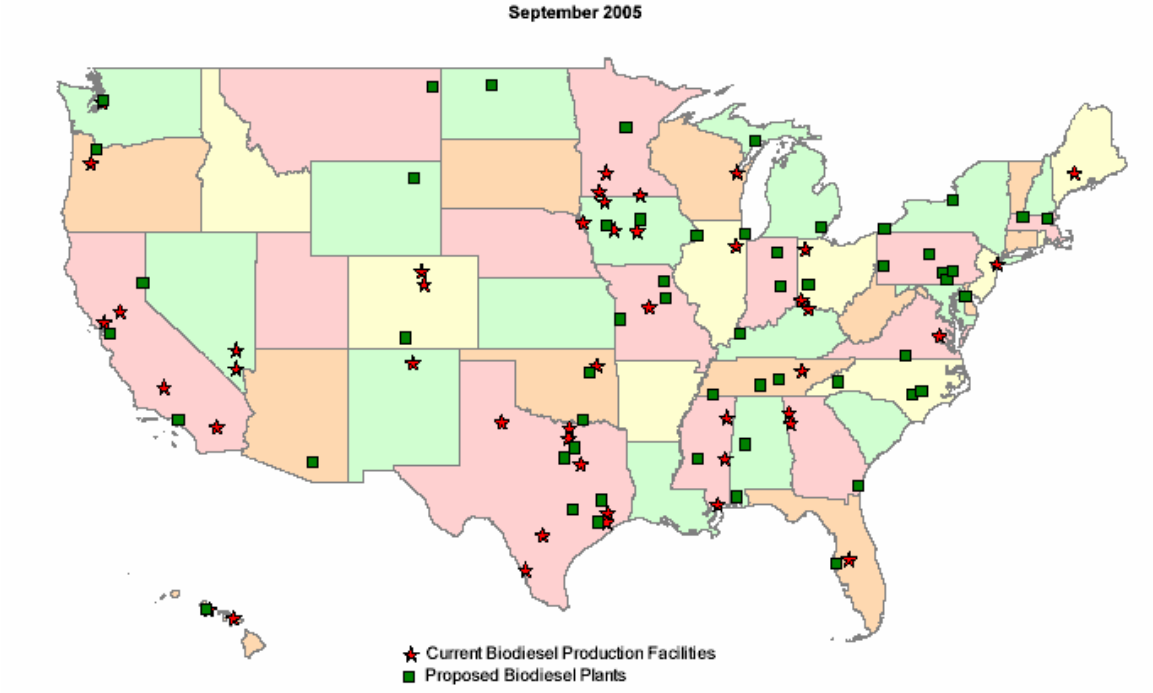
Biodiesel: Markets and Outlook

Biodiesel is one of two primary platform chemicals for the oleochemical industry. The oleochemical industry has already commercialized biomass oil biorefineries. This mature industry consumes 2.6 billion pounds of biomass oil and produces nearly 4 billion pounds of biobased products, chemicals, fuel additives, and biodiesel annually.

Oleochemicals already compete with petrochemicals in many markets on a price and performance basis (detergents, lubricants, solvents, coatings, polymers, etc), but biodiesel remains substantially more expensive than petroleum diesel, limiting its use and acceptance in the marketplace. Biobased purchasing incentives or financial incentives that reduce biomass oil feedstock costs vis-à-vis petroleum feedstock costs could increase demand for oleochemical products and displace some petrochemical products. There is also some potential to increase the oleochemical content of some petrochemical products.

Compared to the ethanol sector, the biodiesel market is still extremely immature, consisting of only a relative handful of dedicated plants in the United States serving the small existing markets for biodiesel. However, production capacity has been increasing rapidly in recent months, likely in response to the biodiesel production incentives in the recently passed energy bill. The National Biodiesel Board estimates existing dedicated biodiesel capacity increased from 110 million gallons in April to about 180 million gallons in September, although actual production and use of biodiesel in the United States was estimated to be about 25 million gallons in 2004. In addition to dedicated production capacity, there is also the capacity for the existing oleochemical industry to produce as much as 110 million gallons of biodiesel per year, suggesting that potential biodiesel production capacity far exceeds current market needs. Figure 6 shows the location of current and proposed biodiesel production facilities as of September 2005.

Figure 6: Current and Proposed Biodiesel Plants



Source: National Biodiesel Board

According to the National Biodiesel Board, there are about 45 existing biodiesel production facilities in the United States, with 15 new facilities added between September and April of this year. In September about 54 companies have reported their plans to construct dedicated biodiesel plants in the near future, dependent upon regional and national demand prospects, up from 25 companies in April. Their combined capacity, if realized, would result in another 570 million gallons per year of biodiesel production potential. However, not all of those projects will see fruition. Capacity is expected to increase by at least 100 million gallons between May 2005 and May 2006, although actual production would likely be much lower since plants do not run at 100% capacity all the time.

From a strictly economic perspective, producing biodiesel is far more expensive than regular petroleum diesel, with feedstock costs accounting for a large percentage of those production costs. It takes about 7.3 pounds of soybean oil, which costs about 20 cents per pound, to produce a gallon of biodiesel. Feedstock costs alone, therefore, are at least $1.50 per gallon of soy biodiesel, even before adding the costs of refining, transportation, storage, etc. Therefore, only under conditions of abnormally high petroleum costs and low feedstock costs can biodiesel compete head-to-head with petroleum diesel on a cost basis. However, fats and greases cost less and produce less expensive biodiesel, sometimes as low as $1.00 per gallon, with the quality equivalent to soy biodiesel fuel.

Given its relatively high cost, biodiesel is largely marketed in blends ranging from 2 percent to 20 percent, allowing expanded usage that provides some of the environmental and air quality benefits over petroleum diesel, with only a modest impact on price per gallon. The 2 percent blend is generally the most affordable and therefore the most

widely available. However, tax credits designed to favor biodiesel can make the final cost to consumers even more competitive with petroleum diesel. For example, Illinois phases out its fuel sale tax for higher blends of biodiesel, making 11 percent biodiesel more affordable than regular diesel fuel in many instances.

Most of the current markets for biodiesel and many biobased lubricants have developed as a result of state and federal government mandates to encourage its use whenever available, including a federal directive for government agencies to purchase and use biobased lubricants and hydraulic fluids in government-owned transportation fleets.

Federal policies to encourage the expansion of the biodiesel industry include several provisions in the recently-passed Energy Bill. These include:

Extension of the Biodiesel Tax Credit: The biodiesel tax credit is extended through December 31, 2008. The credit equates to a one penny per percent of biodiesel in a fuel blend made from agricultural products like vegetable oils, and one-half penny per percent for recycled oils. This incentive is taken by petroleum distributors and passed on to consumers. The USDA developed a study that estimated this incentive will increase the demand for biodiesel to at least 124 million gallons per year. And depending on other factors, including crude oil prices, the industry projects that demand could be much higher

Renewable Fuel Standard (RFS): The mandate for 7.5 billion gallons of renewable fuels be included in the nation's fuel supply by 2012 extends to include biodiesel as well as ethanol. A compliance credit trading program is also established under the RFS. The EPA Administrator is tasked with promulgating the implementing regulations, including appropriate credits for biodiesel.

Credit for Installation of Alternative Fuel Refueling Infrastructure: The installation of infrastructure that dispenses biodiesel blended fuel (B20 minimum) qualifies for this credit.

Small Agri-Biodiesel Producer Tax Credit: Establishes a $.10/gallon tax credit for agribiodiesel producers. The credit is applicable up to 15 million gallons of agri-biodiesel produced and limited to producers under 60 million gallons of annual production.

Biodiesel Engine Testing Program: Provides $5 million/year funding authorization (FY 2006-2010) to initiate a collaborative research project testing biodiesel in advanced diesel engine and fuel system technology.

State Biodiesel Initiatives

Recent initiatives by several states to encourage biodiesel use—often through mandates that require biodiesel be blended with petroleum diesel sold in particular markets or throughout the whole state—are expected to increase biodiesel consumption to beyond 80 million gallons in 2006, with some analysts predicting consumption as high as 125 million gallons by early next year.

In 2003, Minnesota was the first in the nation to pass state legislation that will require nearly all petroleum diesel sold within the state to be blended with 2% biodiesel. The B2 Law requires Minnesota to have a production capacity of at least eight million gallons of biodiesel fuel per year, and approximately 16 million gallons of biodiesel fuel will be needed to meet the state B2 requirement. The law takes effect whenever Minnesota plants come on line, triggering a 30-day public notification. That could happen soon, as two new biodiesel manufacturing plants are expected to come on line by September 2002. When those plants reach full capacity, Minnesota will have available capacity to produce about 63 million gallons of biodiesel annually, making it the largest producer in the nation.

Biodiesel in Indiana

Currently there are plans to open two new biodiesel production facilities in Indiana. Integrity Biofuels has announced it will construct a 10 million gallon facility in Shelby County, IN. Integrity selected this Shelby County town because it is located near Bunge North America's Morristown facility, one of eight soybean processing plants in the state. A subsidiary of the Louis Dreyfus Group has proposed an agricultural-industrial park in Kosciusko County that could eventually include an ethanol plant and a biodiesel plant, with a capacity to produce 100 million gallons of ethanol and 80 million gallons of biodiesel.

Integrity Biofuels has purchased an existing building/warehouse and expects to be producing biodiesel by early 2006. The plant is expected to employee five to seven workers and could expand its output beyond 10 million gallons in later years. In its first year of production, the plant is expected to utilize 6.7 million bushels of Indiana soybeans.

The Louis Dreyfus plant would employ 60 and process more than 140,000 bushels of soybeans a day. It said the company also plans to build a biodiesel plant there capable of processing 80 million gallons annually, and a 100-million gallon ethanol plant, in the second and third phases of development. Construction of the plant and infrastructure is expected to take about 12—18 months.

The decision by these companies to locate in Indiana can be attributed at least partially to state efforts to both expand the local market for biodiesel and provide incentives for its production. Earlier this year, Governor Mitch Daniels signed legislation allowing up to $20 million in tax incentives for biodiesel, blended biodiesel, and ethanol production. Some of the incentives and market promotion activities by Indiana that apply specifically to biodiesel include:

Biodiesel Production Tax Credit: A taxpayer that produces biodiesel at a facility located in Indiana is entitled to a credit of $1 per gallon of biodiesel that is used to produce blended biodiesel (diesel/biodiesel blends of at least 2% biodiesel).

Biodiesel Blending Tax Credit: A taxpayer that produces blended biodiesel at a facility located in Indiana is entitled to a credit of $0.02 per gallon of blended biodiesel. Both the

biodiesel blend and the biodiesel used in the blend must be produced at a facility located in Indiana.

Biodiesel Retailer Tax Credit: Through December 31, 2006, a taxpayer that is a fuel retailer and distributes blended biodiesel for retail purposes in a taxable year is entitled to a credit of $0.01 per gallon of blended biodiesel

Biodiesel Use: Effective July 1, 2005, governmental entities are required to fuel diesel vehicles with biodiesel whenever possible.

Biodiesel Price Preference: A governmental body, state educational institution, or instrumentality of the state that performs essential governmental functions on a statewide or local basis is entitled to a price preference of 10% for the purchase of fuels which are at least 20% biodiesel or a primarily ester-derived fuel

Long-term Outlook and Research Needs:

Government forecasts suggest biomass oils (biodiesel and biolubricants) could displace up to 10 billion gallons of petroleum by 2030 if incentives or mandates are used to promote fuels and biobased products produced from biomass oils. However, in order for biomass oils to displace large quantities of petroleum there must be a well coordinated research programs at the state and national level between both agricultural and energy agencies. In addition, there has to be a clear policy environment that encourages the use of biomass oil fuels and products using tools such as purchasing incentives, tax credits, or mandates. Mandates will be the least expensive of the options but incentives are more politically popular.

Most biomass oils feedstocks exceed distillate prices, limiting petroleum displacement. Without financial incentives, biomass oil fuels will remain niche market fuels where there are environmental or political incentives to use them. Government purchasing preferences may increase demand for some oleochemical products. Blends of biomass oil fuels with petroleum fuels offer the best commercial potential because blends offer superior performance and lower cost than the straight biomass oil fuels themselves.

There are several areas where expanded research efforts could reduce the costs of biodiesel and bio-lubricant production, perhaps making them more competitive with petroleum-based products and expanding there use considerably. These include efforts that focus on increasing yields and reducing costs of high oil seed crops (canola, sunflower, etc.), increasing oil content of soy beans, and increasing demand for soy bean meal. Other areas for targeted research include:

Oil Extraction Technology: Since biomass oil extraction can cost 20 to 44 cents per gallon of oil and up, it provides a large target for cost reductions. Only oil seed costs are higher. Improved oil extraction technology could benefit the existing crushing industry by developing processes that do not use toxic compounds such as *n*-hexane. Improved extraction technology can also reduce oil pretreatment costs, for an additional feedstock cost savings. However, the production of biodiesel is already highly efficient (yields

exceeding 99.7%) and total average production costs are minimized given the constraints of feedstock costs and economies of scale. Investments in processing technology will likely have a limited impact on overall production costs.

Industrial Meal Co-products: Developing new meal coproducts will stimulate the existing crushing industry, expanding oil supplies and reducing their costs. Demand for soybean meal drives the US crushing industry; demand for oil has no real effect on supplies of soybean oil because it's a minor byproduct representing only 19% of the soybean by weight. If the demand for meal in industrial coproducts or applications is stimulated, crushing capacity utilization will increase and the amount of oil produced will increase. The price for oils may fall as oil supplies and crusher's revenues expand. There are large numbers of potential new uses for soy meal in human food, livestock feeding, health products, and industrial products.

Reduce Glycerin Refining Costs: An inevitable byproduct of biodiesel production is glycerol—about 0.73 pounds per gallon of biodiesel. The expansion of biodiesel production worldwide is driving down the value of glycerol and reducing byproduct revenue of biodiesel and oleochemical producers. Further expansion of the biodiesel industry will produce as much as one billions pounds of glycerol and reduce its price to a point where its use may become economical in a wide range of products and processes yet undiscovered. Investments in new uses for glycerin and new products produced from glycerol could enable the rapid expansion of a biodiesel or oleochemical industry However, biodiesel-derived glycerol is poor quality and requires expensive refining before it is suitable for new product technologies. Glycerol refining technology is relatively mature and requires significant economies of scale to be economical. Research into improved production processes could improve glycerin coproduct quality and reduce glycerin-refining costs. In turn, this can expand the ability of biodiesel plants to produce glycerol-base coproducts and generate higher values for their glycerol streams.

Overview: Opportunities and Threats to the U.S. Biofuels Industry

Biofuels production, particularly ethanol, has expanded at a remarkable pace over the last decade and the new Energy Bill provides strong incentives for further, profitable growth. Large and reliable corn supplies at competitive prices are key to maintaining an efficient and competitive ethanol sector and ensuring that individual plants remain profitable under existing market conditions. Because of climate and geography that are very favorable to corn production, the US—and particularly the Midwestern states—is one of the world's major producers of corn, representing 40% of the world's total production

But it is also a fact that the biofuels industry, under normal fuel price conditions, depends heavily on government programs for its continued existence. The broad support for these programs was reflected in the aggressive expansion of biofuel demand mandated in the energy bill passed over the summer. The agricultural sector strongly supports incentives to produce biofuels, and as gasoline prices rose over the summer, support for alternative fuels rose in non-agricultural sectors as well. Support for biofuel programs is expected to continue in the future. However, there are several overriding market and policy issues

that deserve close attention in the years ahead because of their potential to influence demand for biofuels in the future, as well as the short term market prospects for individual firms. These include:

- **Fuel prices:** Ethanol profitability depends on the prices of gasoline, corn feedstocks, and ethanol by-products. Ethanol production has been extremely profitable in recent months due to the historically high prices of gasoline and relatively low prices of corn. However, the extent to which today's high petroleum prices might be a short term phenomenon and at some point return to their long-term declining trend, could erode not only the profitability of ethanol production but also the level of public support for this industry.
- **Federal Support for Ethanol Production:** Current high fuel prices support profitable ethanol production even without the 52¢/gallon exemption to the gasoline excise tax. Although this tax exemption is politically popular especially with farm-state legislators, it has also been criticized by some as a corporate subsidy. Future efforts to redirect government spending and/or increase tax revenues to reduce the burden of a growing budget deficit could create interest in eliminating this tax exemption, especially if market conditions remain such that ethanol production is profitable without this tax incentive. However, it should be noted that there are currently no serious efforts underway at the federal level to change the means or level of support to the ethanol industry.
- **Corn prices:** The expansion in demand for biofuels mandated in the recent energy bill is will significantly increase the demand for corn for ethanol production, and could therefore put upward pressure on corn prices. As noted earlier in this report, higher corn prices—while beneficial to corn farmers—can also reduce margins in other industries that rely on corn as a critical input. The result could be reduced competitiveness in livestock production and a decline in the share of world markets supplied by US corn farmers. Short-term disruptions in corn supply, such as could be caused by severe weather-related damage in some years, could also lead to price spikes that increase the cost of producing ethanol, perhaps to unprofitable levels.
- **Competing supplies (domestic and international):** Brazil is the world's largest exporter of ethanol, which it makes from sugarcane feedstock, and has already secured a promise from the EU to open a tariff-rate quota of 1.3 billion gallons for ethanol exports from Brazil if they ever succeed in finalizing the EU-Mercosur bilateral trade agreement. Brazil officials have publicly questioned how the biofuels consumption mandate in the energy bill would be met if a poor US corn harvest led to significantly reduced ethanol production. Brazil exported 89 million gallons of ethanol to the United States in 2004, and could greatly expand this amount particularly if the current tariff on ethanol imports were significantly reduced or eliminated. The energy bill also included incentives to develop alternate feedstocks for ethanol production, like cellulose. Technological advances in lowering the cost of using these feedstocks to produce biofuels could lower the demand for corn as a biofuel feedstock.